Series 3730
Electropneumatic Positioner
Type 3730-6

with HART®communication and pressure sensors

Fig. 1 · Type 3730-6

HART COMMUNICATION PROTOCOL

Mounting and Operating Instructions

EB 8384-6 EN

Firmware version 1.01

Edition February 2012

Definitions of the signal words used in these instructions

△ ***DANGER!***
indicates a hazardous situation which, if not avoided, will result in death or serious injury.

WARNING!
indicates a hazardous situation which, if not avoided, could result in death or serious injury.

NOTICE
indicates a property damage message.

Note: *Supplementary explanations, information and tips*

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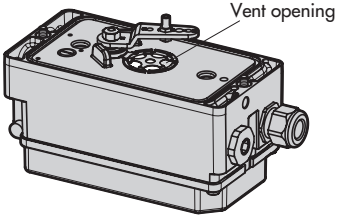
1 Important safety instructions

For your own safety, follow these instructions concerning the mounting, start-up and operation of the positioner:

- The positioner is to be mounted, started up or operated only by trained and experienced personnel familiar with the product.
  According to these Mounting and Operating Instructions, trained personnel refers to individuals who are able to judge the work they are assigned to and recognize possible dangers due to their specialized training, their knowledge and experience as well as their knowledge of the applicable standards.
- Explosion-protected versions of this positioner may only be operated by personnel who have undergone special training or instructions or who are authorized to work on explosion-protected devices in hazardous areas. Refer to section 11.
- Any hazards that could be caused by the process medium, the operating pressure, the signal pressure or by moving parts of the control valve are to be prevented by means of the appropriate measures.
- If inadmissible motions or forces are produced in the actuator as a result of the supply pressure, the supply pressure must be restricted by means of a suitable supply pressure reducing station.

To avoid damage to any equipment, the following also applies:

- Do not operate the positioner with the back of the positioner/vent opening facing upwards.
  The vent opening must not be sealed when the positioner is installed on site



- Proper shipping and appropriate storage are assumed.
- Do not ground electric welding equipment near to the positioner.

Note: *The device with a CE marking fulfills the requirements of the Directives 94/9/EC (ATEX) and 89/336/EEC (EMC).*
The Declaration of Conformity is available on request.

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2 Article code

Positioner		Type 3730-6-	xxxxxx	x	0	x	x	0	x	0	0
With HART® communication and pressure sensors											
Explosion protection											
ATEX: Ⓔx II 2 G Ex ia IIC/IIB T6; II 2 D Ex tD A21 IP 66 T 80°C		110									
IECEx: Ex ia IIC/IIB T6; Ex d[ia] IIC/IIB T6; Ex tD A21 IP 66 T 80°C		111									
GOST: 1Ex ia IIC T6 X, DIP A21 Ta80°C, IP 66		113									
ATEX: Ⓔx II 3 G Ex nA II T6; II 3 G Ex nL IIC/IIB T6; II 3 D Ex tD A22 IP 66 T 80°C		810									
IECEx: Ex nA II T6; Ex nL IIC/IIB T6; Ex tD A22 IP 66 T 80°C		811									
GOST: Ex nA II T6, Ex nL IIC T6, DIP A22 Ta80°C, IP 66		813									
Options (additional equipment)											
Inductive limit switch	Without		0								
	With SJ2-SN		1		0						
	With SJ2-S1N		2								
Venting function	Without			0							
	Solenoid valve 24 V DC			1							
	Forced venting 24 V DC			2							
Additional equipment	Without				0						
	Position transmitter				1						
	Leakage sensor				2	0					
	Binary input				3						
External position sensor	Without					0					
	Including 10 m connecting cable					1			1		
	Prepared for connection, without sensor					2					
Emergency shutdown	3.8 mA							0			
	4.4 mA							1			
Housing material											
Standard aluminum									1		
Stainless steel 1.4581									2		
Special applications											
None											0
Compatible with paint											1
Exhaust air connection with ¼–18 NPT thread, back of positioner housing sealed											2
Attachment according to VDI/VDE 3847											6

3 Design and principle of operation

The electropneumatic positioner is attached to pneumatic control valves. It is used to assign the valve stem position (controlled variable x) to the control signal (reference variable w). The input signal received from a control system is compared to the travel or rotational angle of the control valve, and a pneumatic signal pressure (output variable y) is produced.

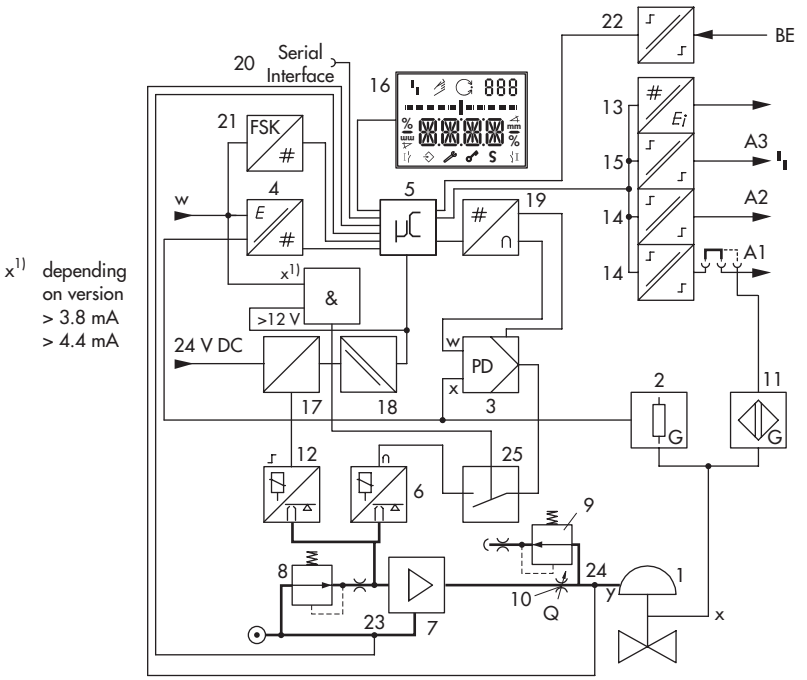
The positioner basically consists of an electrical travel sensor system (2), an analog i/p converter (6) with downstream air capacity booster (7) and the electronics unit with a microcontroller (5).

The standard positioner is fitted with three binary contacts: A fault alarm output indicates a fault to a control station and two configurable software limit switches are used to indicate the end positions of the valve.

The valve position (x) is transmitted as a linear travel motion or an angle of rotation by the pick-up lever and travel sensor (2) to an analog PD controller (3). Simultaneously, an A/D converter (4) transmits the position of the valve to the microcontroller (5). The PD controller compares this valve position to the 4 to 20 mA DC control signal supplied by the controller after it has been converted by the A/D converter (4). In case of a system deviation, the actuator (1) is either vented or filled with more air by changes to the i/p converter (6). This causes the valve plug to adopt the position corresponding to the reference variable (w).
The supply air is supplied to the air capacity booster (7) and the pressure regulator (8). An intermediate flow regulator (9) with fixed settings is used to purge the positioner and also guarantees trouble-free operation of the air capacity booster. The output signal pressure supplied by the booster can be limited over the software. Both pressure sensors (23 and 24) monitors the supply pressure p_s and the signal pressure p_{out}.
The volume restriction Q (10) is used to optimize the positioner.

The positioner is suitable for the following types of attachment using the corresponding accessories:

- Direct attachment to SAMSON Type 3277 Actuator: Section 4.1
- Attachment to actuators acc. to IEC 60534-6 (NAMUR): Section 4.2
- Attachment to Type 3510 Micro-flow Valve: Section 4.3
- Attachment to rotary actuators acc. to VDI/VDE 3845: Section 4.4



1 Control valve
2 Travel sensor
3 PD controller
4 A/D converter
5 Microcontroller
6 i/p converter
7 Air capacity booster
8 Pressure regulator
9 Flow regulator
10 Volume restriction
11* Inductive limit switch
12* Solenoid valve
13* Analog position transmitter or binary input
14 Software limit switches A1/A2
15 Fault alarm output A3
16 LCD
17* Solenoid valve control
18* Galvanic isolation
19 D/A converter
20 Communication interface
21 HART® modulation
22* Binary input BE
23 Pressure sensor for supply pressure p_s
24 Pressure sensor for signal pressure p_{out}
25* Forced venting
* Option

Fig. 2 · Functional diagram

3.1 Safety function (SIL)

The safety function is based on the shutdown of the i/p converter (6). This causes the pneumatic actuator to be vented and the valve to move to its fail-safe position.

Monitoring of the input signal

The i/p converter is switched off when the input signal of the positioner at terminals +11/−12 falls below 3.8 mA or 4.4 mA depending on the positioner version (a signal range of 4 to 20 mA is required). See Fig. 18 on page 48.

Monitoring the voltage supply
(version with forced venting **and** solenoid valve)

The i/p converter and the solenoid valve (when installed) are shut down whenever the voltage at terminals +81/−82 falls below 12 V (an input voltage of 24 V DC is required). See Fig. 18 on page 48.

When the i/p converter is switched off by the monitoring of the input signal or the voltage supply, the fail-safe position ***S*** is activated and is indicated on the positioner display.

If required, the user can check the safety function using the software.
For more details, refer to the Operating Instructions EB 8389-1 EN on EXPERTplus Valve Diagnostics.

3.2 Valve diagnostics

The **EXPERTplus** valve diagnostics are integrated into the positioner. They provide information on the valve condition (see Table 1) and generate status messages to quickly pinpoint faults.

For more details, refer to the Operating Instructions EB 8389-1 EN on EXPERTplus Valve Diagnostics.

3.3 Flow rate calculation

Due to the differential pressure measurement Δp out, EXPERTplus is able to calculate the flow rate in a SAMSON Type 3241 or Type 3251 Valve, provided all the parameters regarding the medium and the process have been defined in the positioner.

For more details, refer to the Operating Instructions EB 8389-1 EN on EXPERTplus Valve Diagnostics.

Table 1 · Diagnostic functions and diagnosis,
(refer to the Operating Instructions EB 8389-1 EN on EXPERTplus Valve Diagnostics for more details)

Diagnostic function	Control valve	On/off valve	Diagnosis
Monitoring			
Data logger	•	•	Depending on trigger condition selected
Valve signature	•	⊗	– Friction – Supply pressure – Actuator springs – Pneumatic leakage
On/off valve	–	•	– Breakaway time – Transit time – Final travel/angle value
Valve position histogram	•	⊗	– Course of the manipulated variable range – Manipulated variable range
Set point deviation histogram	•	•	– Manipulated variable range limitation – Seat leakage – Positioner-valve linkage – Max. set point deviation
Cycle counter histogram	•	•	– Packing leakage – Dynamic load factor
Leakage sensor	•	•	– Seat leakage
Course of end position	•	•	– Course of end position – Zero point shift
Dynamic tests			
Valve dead band	•	•	– Dead band
Partial stroke test (PST)	•	•	– Overshooting – Dead time – T86 – Settling time
Full stroke test (FST)	•	•	– Overshooting – Dead time – T86 – Settling time

• Full scope of functions
⊗ Function is performed, but not analyzed
– Function is not performed

3.4 Type of application

There are two different types of application: **Control valve** and **On/off valve**. The automatic mode ↻ (AUTO) and manual mode ✋ (MAN) can be selected in both types of applications.

Operating mode	Control valve	On/off valve
Automatic	The positioner follows the reference variable (w) continuously.	Discrete analysis of the reference variable (w).
Reading on display	Valve position x in %	Valve position x in % and ***O/C*** (Open/Close) in alternating sequence
Manual	The positioner follows the manual set point given over local operation.	

The application type is set in Code **49 - h** (see section 7.8).

Note:
- *Depending on the application type, certain diagnostic functions cannot be performed or analyzed. See Table 1.*
- *Section 7.8 contains details on discrete analysis of on/off valves.*
- *In manual mode, an on/off valve can be moved past 100 % of the nominal range (with the closed position for ATO) or below 0 % of the nominal range (with the closed position for ATC). See section 7.1 for valve closed position.*

3.5 Communication

The positioner is equipped with an interface for HART® protocol (Highway Addressable Remote Transducer) for communication purposes. Data are transmitted in a superimposed frequency (FSK = Frequency Shift Keying) on the existing signal loop for the 4 to 20 mA reference variable.

Either a HART® capable handheld communicator or a computer with FSK modem can be used to establish communication and operate the positioner.

3.5.1 Configuration using TROVIS-VIEW 4

The positioner can be configured using the TROVIS-VIEW 4 software for configuration and operation. The positioner is equipped for this purpose with an additional digital **SERIAL INTERFACE** to allow a computer to be connected over an adapter cable from the RS-232 or USB port of the computer to the positioner.
The TROVIS-VIEW 4 software enables the user to easily set parameters in the positioner and view process parameters online.

Note: *TROVIS-VIEW 4 is a free software which can be downloaded from the SAMSON website (**www.samson.de > Services > Support & Downloads**).*

3.6 Additional equipment

Inductive limit switch

In the version with inductive limit switch, the rotary shaft of the positioner carries an adjustable tag which actuates the installed proximity switch. The optional inductive limit switch (11) is connected to A1, while the remaining software limit switch is connected to A2.

Solenoid valve

If the operating voltage for the solenoid valve (12) falls under 12 V, the supply pressure for the i/p converter (6) is vented to the atmosphere. The positioner can no longer operate and the control valve moves to the fail-safe position determined by the actuator, independent of the reference variable. **In manual mode, the manual set point is reset to 0 %. A different manual set point must entered again.**

Forced venting

If the voltage signal at terminals +81/–82 falls below 12 V, the i/p converter (6) is de-energized. The positioner vents the actuator, causing valve to move to the fail-safe position determined by the actuator, independent of the reference variable.

Analog position transmitter

The position transmitter (13) is a two-wire transmitter and issues the travel sensor signal as a 4 to 20 mA signal processed by the microcontroller. Since this signal is issued independent of the positioner's input signal, the momentary travel/angle of rotation is controlled in real-time. Additionally, the position transmitter allows positioner faults to be indicated over a signal current of < 2.4 mA or > 21.6 mA.

Leakage sensor

By upgrading the positioner with a leakage sensor, it is possible to detect seat leakage when the valve is in the closed position. For more details, refer to the Operating Instructions EB 8389-1 EN on EXPERTplus Valve Diagnostics.

Binary input

The optional binary input can be configured:

- To connect a floating contact
- To connect a non-floating contact (0 to 24 V DC)

By selecting a certain function, one of the following actions can be activated:

- Transmit switching state
  The switching state of the binary input is logged.
- Activate local write protection
  After the first initialization, a local write protection can be activated. While the binary input is active, no settings can be changed at the positioner. The positioner cannot be re-initialized. Configuration enabling over **Code 3** is not active (🔧).
- Start PST
  The positioner start a single partial stroke test. The test is performed with the settings in **Code 49 - d2** to **Code 49 - d9** (refer to Operating Instructions EB 8389-1 EN on EXPERTplus Valve Diagnostics).
- Move valve to safety set point
  An on/off valve moves to the predeter-

mined safety set point when the positioner is in automatic mode ↻ (AUTO). This function is not performed in the manual mode ✋ (MAN) or fail-safe position mode (SAFE).

- Switch AUTO/MANUAL
  The positioner changes from the automatic mode ↻ (AUTO) to the manual mode ✋ (MAN) or vice versa.
  This function is not performed if the positioner is in the fail-safe position mode (SAFE).
- Start data logger
  The data logger starts recording when the binary input is activated (refer to Operating Instructions EB 8389-1 EN on EXPERTplus Valve Diagnostics).
- Reset diagnostics
  Active tests and monitoring are stopped and the diagnostic data is reset once.

Additionally, the external solenoid valve function can be selected if a non-floating contact is configured:

- External solenoid valve
  The voltage for an external solenoid valve is connected in parallel to terminals +81/–82. This allows the switching state of the solenoid valve to be monitored.

Note: *The optional binary input can only be configured using the operator software e.g. TROVIS-VIEW 4. The switching state is transmitted when the switch is closed by default.*

External position sensor

In this version, only the sensor is mounted to the control valve. The positioner is located separately from the valve.
The connection of controlled variable (x) and output variable (y) signals to the valve is established by cable and piping for air.

3.7 Technical data

Type 3730-6 Positioner (technical data in test certificates additionally apply for explosion-protected devices)		
Travel, adjustable		Direct attachment to Type 3277: 3.6 to 30 mm Attachment acc. to IEC 60534-6: 3.6 to 200 mm Rotary actuators: 24° to 100°
Travel range		Adjustable within the initialized travel/angle of rotation Travel can be restricted to 1/5 at the maximum
Ref. variable w	Signal range	4 to 20 mA · Two-wire unit with reverse polarity protection · Min. span 4 mA
	Static destruction limit	30 V
Minimum current		3.6 mA for display · Emergency venting at ≤ 3.8 mA
Load impedance		≤ 9.2 V (corresponding to 460 Ω at 20 mA)
Supply air	Supply pressure	1.4 to 7 bar (20 to 105 psi)
	Air quality ISO 8573-1 (2001-02)	Max. particle size and density: Class 4 · Oil content: Class 3 pressure dew point: Class 3 or at least 10 K beneath the lowest ambient temperature to be expected
Signal pressure (output)		0 bar up to the capacity of supply pressure · Limitable between 1.4 and 7.0 bar by software
Characteristic	Adjustable	Linear, equal percentage, reverse equal percentage, user-defined (by software) Butterfly, rotary plug and segmented ball valves: linear/equal percentage
	Deviation	≤ 1 %
Hysteresis		≤ 0.3 %
Sensitivity		≤ 0.1 %
Transit time		Separately adjustable up to 240 seconds for supply air and exhaust air by software
Direction of action		Reversible
Air consumption, steady state		Independent from supply pressure approx. 110 l_n/h
Air output capacity	Actuator pressurized	At Δp = 6 bar: 8.5 m_n^3/h · At Δp = 1.4 bar: 3.0 m_n^3/h · $K_{Vmax\ (20\ °C)}$ = 0.09
	Actuator vented	At Δp = 6 bar: 14.0 m_n^3/h · At Δp = 1.4 bar: 4.5 m_n^3/h · $K_{Vmax\ (20\ °C)}$ = 0.15
Permissible ambient temperature		–20 to +80 °C for all versions –45 to +80 °C with metal cable gland –25 to +80 °C with inductive limit switch (SJ2-S1N) and metal cable gland Limits in test certificate additionally apply for explosion-protected devices
Influences	Temperature	≤ 0.15 %/10 K
	Supply air	None
	Vibration	≤ 0.25 % up to 2000 Hz and 4 g acc. to IEC 770
Electromagnetic compatibility		Complying with requirements of EN 61000-6-2, EN 61000-6-3, EN 61326-1 and NAMUR Recommendation NE 21

Type 3730-6 Positioner (technical data in test certificates additionally apply for explosion-protected devices)		
Electrical connections		One M20 x 1.5 cable gland for 6 to 12 mm clamping range · Additional second M20 x 1.5 threaded hole · Screw terminals for 0.2 to 2.5 mm² wire cross-section
Degree of protection		IP 66/NEMA 4X
Use in safety-instrumented systems in compliance with IEC 61508/SIL		**Suitable for use in safety-instrumented systems up to SIL 2** – triggered by the set point, emergency venting at ≤ 3.8 mA or ≤ 4.4 mA depending on the positioner version – by the optional forced venting, emergency venting at ≤ 12 V **Suitable for use in safety-instrumented systems up to SIL 3** The current circuit of the set point and the forced venting must both be operated in a safety-related system
Communi-cation	Local	SAMSON SSP interface and serial interface adapter Software requirement (SSP): TROVIS-VIEW with database module 3730-6
	HART®	HART® field communication protocol Impedance in HART frequency range: receive 350 to 450 Ω, send: approx. 155 Ω Software requirements (handheld communicator): device description for Type 3730-6 Software requirements (PC): DTM file acc. to Specification 1.2, suitable for integrating the positioner in frame applications that supports the FDT/DTM concept (e.g. PACTware)
Explosion protection	ATEX	Type 3730-6-110: ⟨Ex⟩ II 2 G Ex ia IIC/IIB T6; II 2 D Ex tD A21 IP 66 T 80 °C Type 3730-6-810: ⟨Ex⟩ II 3 G Ex nA II T6; II 3 G Ex nL IIC/IIB T6; ⟨Ex⟩ II 3 D Ex tD A22 IP 66 T 80 °C
	IECEx	Type 3730-6-111: Ex ia IIC/IIB T6; Ex d [ia] IIC/IIB T6; Ex tD A21 IP 66 T 80 °C Type 3730-6-811: Ex nA II T6; Ex nL IIC/IIB T6; Ex tD A22 IP 66 T 80 °C
	GOST	Type 3730-6-113: 1Ex ia IIC T6 X, DIP A21 Ta80°C, IP 66 Type 3730-6-813: Ex nA II T6, Ex nL IIC T6, DIP A22 Ta80°C, IP 66
Binary contacts		
2 software limit switches, reverse polarity protection, floating, configurable switching characteristics (default settings according to table)		
Signal status	No response	≤ 1.2 mA
	Response	≥ 2.1 mA
1 fault alarm contact, floating		
Signal status	No response/No alarm	≥ 2.1 mA
	Response/Fault alarm	≤ 1.2 mA
For connection to		NAMUR switching amplifier acc. to EN 60947-5-6
Materials		
Housing		Die-cast aluminum EN AC-AlSi12(Fe) (EN AC-44300) acc. to DIN EN 1706, chromated and powder paint coated · Special version: Stainless steel 1.4581
External parts		Stainless steel 1.4571 and 1.4301
Cable gland		Polyamide, black, M20 x 1.5
Weight		Approx. 1.0 kg

Options for Type 3730-6 Positioner	
Inductive limit switch	For connection to switching amplifier acc. to EN 60947-5-6. Can be used in combination with a software limit switch.
SJ2-SN proximity switch	NAMUR NC contact
SJ2-S1N proximity switch	NAMUR NO contact
Solenoid valve · Approval acc. to IEC 61508/SIL	
Input	24 V DC reverse polarity protection, static destruction limit 40 V Current consumption $I = \frac{U - 5.7\ V}{3840\ \Omega}$ (corresponding to 4.8 mA at 24 V/114 mW)
Signal "0" no pick-up	≤ 12 V
Signal "1" safe pick-up	> 19 V
Service life	> 5 x 10^6 switching cycles
Use in safety-instrumented systems in compliance with IEC 61508/SIL	**Suitable for use in safety-instrumented systems up to SIL 2** – triggered by the set point, emergency venting at ≤ 3.8 mA or ≤ 4.4 mA depending on the positioner version – by the optional forced venting, emergency venting at ≤ 12 V **Suitable for use in safety-instrumented systems up to SIL 3** The current circuit of the set point and the forced venting must both be operated in a safety-related system
Forced venting· Approval acc. to IEC 61508/SIL	
Input	24 V DC reverse polarity protection, static destruction limit 40 V Current consumption $I = \frac{U - 5.7\ V}{3840\ \Omega}$ (corresponding to 4.8 mA at 24 V/114 mW)
Signal "0" no pick-up	≤ 12 V
Signal "1" safe pick-up	> 19 V
Use in safety-instrumented systems in compliance with IEC 61508/SIL	**Suitable for use in safety-instrumented systems up to SIL 2** – triggered by the set point, emergency venting at ≤ 3.8 mA or ≤ 4.4 mA depending on the positioner version – by the optional forced venting, emergency venting at ≤ 12 V **Suitable for use in safety-instrumented systems up to SIL 3** The current circuit of the set point and the forced venting must both be operated in a safety-related system
Analog position transmitter	Two-wire transmitter · Galvanically isolated
Supply voltage	12 to 30 V DC · Reverse polarity protection · Static destruction limit 40 V
Output signal	4 to 20 mA
Direction of action	Reversible
Operating range	–10 to +114 %
Characteristic	Linear
Hysteresis and HF influence or other influences	Same as positioner
Fault indication	Can be issued with current signal 2.4 ±0.1 mA or 21.6 ±0.1 mA

Options for Type 3730-6 Positioner		
Binary input · Galvanically isolated · Switching behavior configured over software		
Active switching behavior (default setting)		
Connection		For external switch (floating contact) or relay contacts
Electrical data		Open-circuit voltage when contact is open: max. 10 V, pulsed DC current with peak value of 100 mA and RMS current 0.01mA when the contact is closed
Contact	Closed, R < 20 Ω	Switching state ON (default)
	Open, R > 400 Ω	Switching state OFF (default)
Passive switching behavior		
Connection		For externally applied DC voltage, reverse polarity protection
Electrical data		3 to 30 V · Destruction limit: 40 V · Current draw at 24 V: 3.7 mA
Voltage	> 6 V	Switching state ON (default)
	< 1 V	Switching state OFF (default)
External position sensor		
Travel		Same as positioner
Cable		10 m with M12x1 connector, designed for continuous flexing, flame retardant acc. to VDE 0472, resistant to oils, lubricants, coolants as well as other corrosive media
Permissible ambient temperature		–60 to +105 °C · Limits specified in the EC Type Examination Certificate additionally apply for explosion-protected devices.
Vibration immunity		Up to 10 g in the range between 10 and 2000 Hz
Degree of protection		IP 67

4 Attachment to the control valve – Mounting parts and accessories

WARNING!
Attach the positioner, keeping the following sequence:
1. Mount the positioner on the control valve
2. Connect the supply air
3. Connect the electrical power
4. Perform the start-up settings

The positioner is suitable for the following types of attachment:

- Direct attachment to SAMSON Type 3277 Actuator
- Attachment to actuators according to IEC 60534-6 (NAMUR)
- Attachment to Type 3510 Micro-flow Valve
- Attachment to rotary actuators

NOTICE
Attach the positioner to the control valve, observing the following instructions to avoid damaging the positioner.
– *Use only the mounting parts/accessories listed in the Tables 2 to 6 (pages 41 to 43) to mount the positioner. Observe the type of attachment!*
– *Observe the assignment between lever and pin position (see travel tables on page 21)!*

Lever and pin position

The positioner is adapted to the actuator and to the rated travel by the lever on the back of the positioner and the pin inserted into the lever.

The travel tables on page 21 show the maximum adjustment range at the positioner. The travel that can be implemented at the valve is additionally restricted by the selected fail-safe position and the required compression of the actuator springs.

The positioner is standard equipped with the lever **M** (pin position **35**).

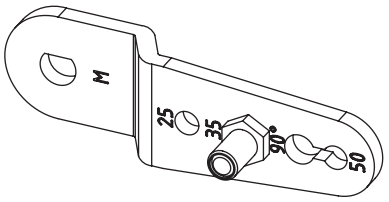


Fig. 3 · Lever M with pin position 35

NOTICE
The lever must be held stationary in the mid position while undoing or fastening the nut to ensure that the lever does not move to one of the end stops.

Travel tables

__Note:__ The lever __M__ is included in the scope of delivery.
Levers __S__, __L__, __XL__ for attachment according to IEC 60534-6 (NAMUR) are available as accessories (see Table 4 on page 42).

Direct attachment to Type 3277-5 and Type 3277 Actuators

Actuator size	Rated travel	Adjustment range at positioner			Required lever	Assigned pin position
[cm²]	[mm]	Min.	Travel	Max.		
120	7.5	5.0	to	25.0	M	25
120/240/350	15	7.0	to	35.0	M	35
355/700	30	10.0	to	50.0	M	50

Attachment according to IEC 60534-6 (NAMUR)

SAMSON valves/Type 3271 Actuator		Other valves/actuators			Required lever	Assigned pin position
Actuator size	Rated travel					
[cm²]	[mm]	min.	Travel	max.		
60 and 120 with Type 3510 Valve	7.5	3.6	to	18.0	S	17
120	7.5	5.0	to	25.0	M	25
120/240/350	15	7.0	to	35.0	M	35
700	7.5					
700	15 and 30	10.0	to	50.0	M	50
1000/1400/2800	30	14.0	to	70.0	L	70
1000/1400/2800	60	20.0	to	100.0	L	100
1400/2800	120	40.0	to	200.0	XL	200

Attachment to rotary actuators according to VDI/VDE 3845

Rotary actuators			Required lever	Assigned pin position
Min.	Opening angle	Max.		
24	to	100°	M	90°

4.1 Direct attachment

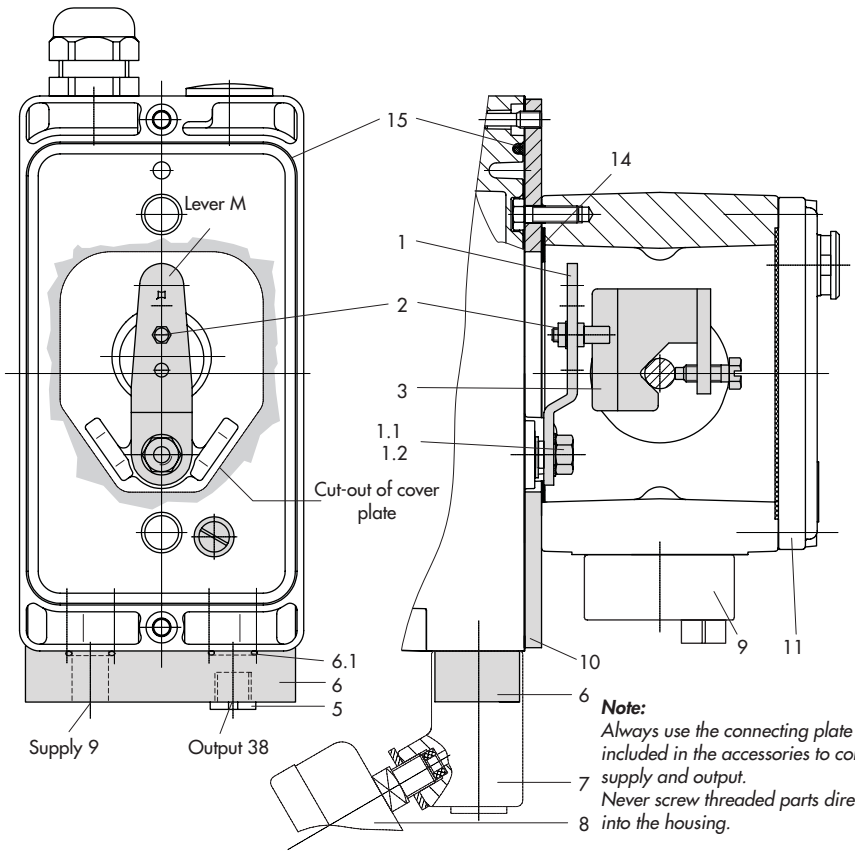
4.1.1 Type 3277-5 Actuator

Refer to Table 2 on page 41 for the required mounting parts and accessories.
Note the travel table on page 21!

Actuator with 120 cm²

1. Mount connecting plate (9) on the actuator.
2. Mount connecting plate (6) or pressure gauge bracket (7) with pressure gauges onto the positioner, making sure both seal rings (6.1) are seated properly.
3. Place follower clamp (3) on the actuator stem, align and screw tight so that the mounting screw is located in the groove of the actuator stem.
4. Mount cover plate (10) with narrow side of the cut-out opening (Fig. 4, left) pointing towards the signal pressure connection. Make sure that the bonded gasket (14) points towards the actuator yoke.
5. **15 mm travel:** Keep the follower pin (2) at lever **M** (1) on the back of the positioner in the pin position **35** (delivered state).
   7.5 mm travel: Remove the follower pin (2) from the pin position **35**, reposition it in the bore for pin position **25** and screw tight.
6. Insert formed seal (15) in the groove of the positioner housing.
7. Place positioner on the cover plate (10) in such a manner that the follower pin (2) rests on the top of the follower clamp (3). Adjust the lever (1) correspondingly and open the positioner cover to hold the positioner shaft in position at the cap or the switch (Fig. 21 on page 53).
   The lever (1) must rest on the follower clamp with spring force.
   Mount the positioner on the cover plate (10) using the two fixing screws.
8. Mount cover (11) on the other side. Make sure that the vent plug points downwards when the control valve is installed to allow any condensed water that collects to drain off.
9. Connect output (38) over the piping/tubing to the connecting plate on the actuator (9).

NOTICE
The signal pressure output at the back is not used in the Type 3730-6 (see EB 8384-0 to -5 EN).



1 Lever
1.1 Nut
1.2 Disk spring
2 Follower pin
3 Follower clamp
5 Stopper
6 Connecting plate
6.1 Seal rings
7 Pressure gauge bracket
8 Pressure gauge mounting kit
9 Connecting plate for actuator
10 Cover plate
11 Cover
14 Gasket
15 Formed seal

Fig. 4 · Direct attachment - Signal pressure connection for Type 3277-5 Actuator with 120 cm²

4.1.2 Type 3277 Actuator

Refer to Table 3 on page 42 or the required mounting parts and the accessories.
Note the travel table on page 21!

Actuators with 240 to 700 cm²

Mount the positioner on the yoke as shown in Fig. 5. The signal pressure is routed to the actuator over the connection block (12), for actuators with fail-safe action "Actuator stem extends" internally through a bore in the valve yoke and for "Actuator stem retracts" through external piping.

1. Place follower clamp (3) on the actuator stem, align and screw tight so that the mounting screw is located in the groove of the actuator stem.
2. Mount cover plate (10) with narrow side of the cut-out opening (Fig. 5, on the left) pointing towards the signal pressure connection. Make sure that the bonded gasket (14) points towards the actuator yoke.
3. For actuators with 355/700 cm², remove the follower pin (2) at lever **M** (1) on the back of the positioner from pin position **35**, reposition it in the bore for pin position **50** and screw tight.
   For actuators 240 and 350 cm² with 15 mm travel, the follower pin (2) remains in pin position **35**.
4. Insert formed seal (15) in the groove of the positioner housing.
5. Place positioner on the cover plate in such a manner that the follower pin (2) rests on the top of the follower clamp (3). Adjust the lever (1) correspondingly and open the positioner cover to hold the positioner shaft in position at the cap or the switch (Fig. 21 on page 53).
   The lever (1) must rest on the follower clamp with spring force.
   Mount the positioner on the cover plate (10) using the two fixing screws.
6. Make sure that the tip of the gasket (16) projecting from the side of the connection block (12) is positioned above the actuator symbol that corresponds with the actuator with fail-safe action "Actuator stem extends" or "Actuator stem retracts." If necessary, remove the three fixing screws and the cover. Then reposition the gasket (16) turned by 180°. The previous version of the connection block (Fig. 5, bottom) requires the switch plate (13) to be turned such that the corresponding actuator symbol points to the marking.
7. Place the connection block (12) with the associated seal rings against the positioner and the actuator yoke. Screw it tight using the fixing screw (12.1).
   For actuators with fail-safe action "Actuator stem retracts", additionally remove the stopper (12.2) and fit on the external signal pressure piping.
8. Mount cover (11) on the other side. Make sure that the vent plug points downwards when the control valve is installed to allow any condensed water that collects to drain off.

1	Lever	12	Connection block
1.1	Nut	12.1	Screw
1.2	Disk spring	12.2	Stopper or connection for external piping
2	Follower pin	13	Switch plate
3	Follower clamp	14	Gasket
10	Cover plate	15	Formed seal
11	Cover	16	Gasket
11.1	Vent plug		

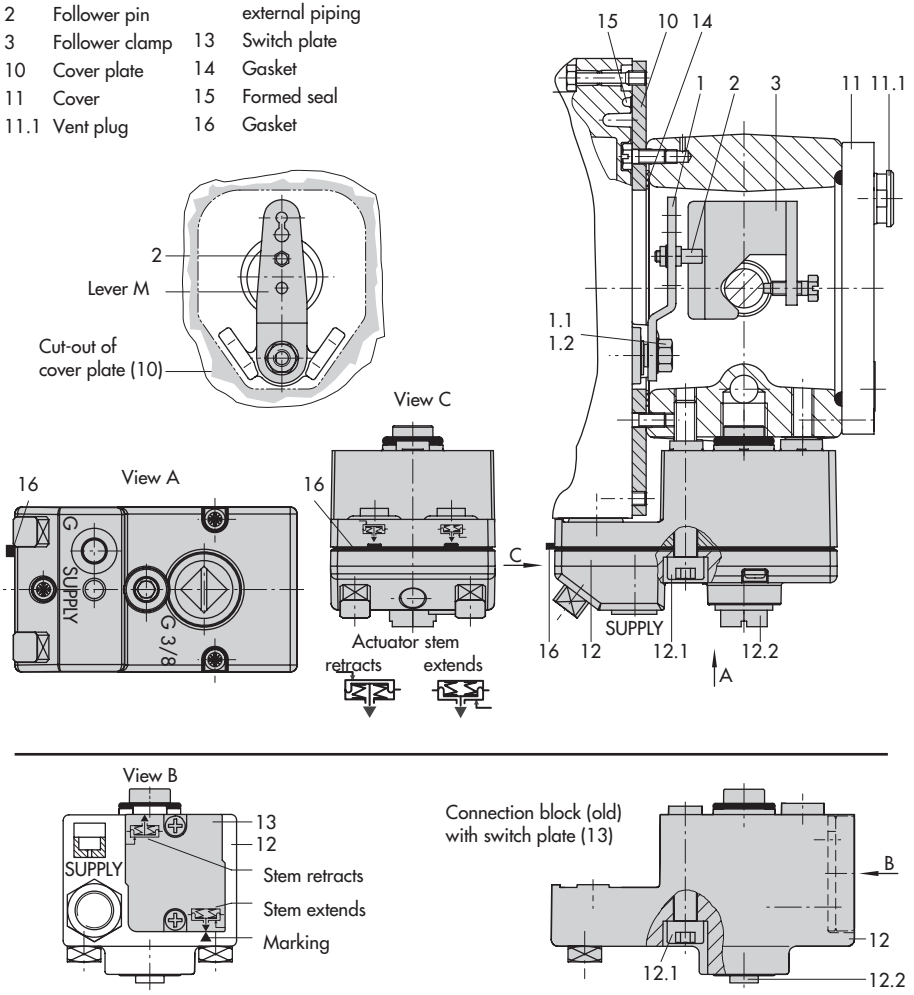


Fig. 5 · Direct attachment – Signal pressure connection for Type 3277 Actuator with 240, 350, 355 and 700 cm²

4.2 Attachment according to IEC 60534-6 (NAMUR)

Refer to Table 4 on page 42 for the required mounting parts and the accessories.
Note the travel table on page 21!

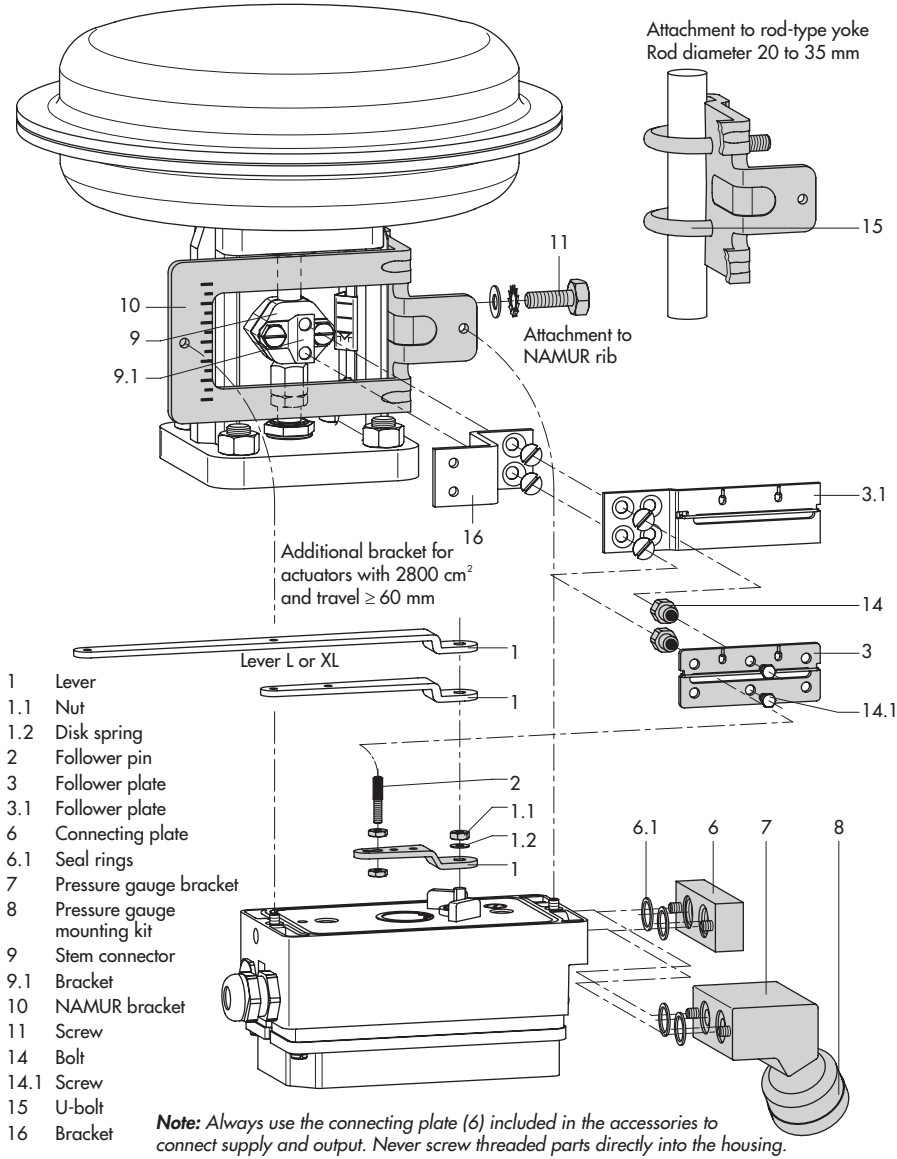
The positioner is attached to the control valve with a NAMUR bracket (10).

1. Screw the two bolts (14) to the bracket (9.1) of the stem connector (9), place the follower plate (3) on top and use the screws (14.1) to tighten.
   Actuator size 2800 cm² and 1400 cm² (120 mm travel):
   – For a travel of 60 mm or smaller, screw the longer follower plate (3.1) directly to the stem connector (9).
   – For a travel exceeding 60 mm, mount the bracket (16) first and then the follower plate (3) to the bracket together with the bolts (14) and screws (14.1).
2. Mount NAMUR bracket (10) to the control valve as follows:
   – For attachment to the NAMUR rib, use an M8 screw (11), washer and toothed lock washer directly in the existing yoke bore.
   – For attachment to valves with rod-type yokes, use two U-bolts (15) around the yoke.
   Align the NAMUR bracket (10) in such a way that the slot of the follower plate (3) is centrally aligned with the NAMUR bracket at mid valve travel.
3. Mount connecting plate (6) or pressure gauge bracket (7) with pressure gauges (8) on the positioner, making sure both seal rings (6.1) are seated properly.
4. Select required lever size (1) **M**, **L** or **XL** and pin position according to the actuator size and valve travels listed in the table on page 21.
   Should you require a pin position other than position **35** with the standard installed lever **M**, or require a lever size **L** or **XL**, proceed as follows:

NOTICE
The lever must be held stationary in the mid position while undoing or fastening the nut to ensure that the lever does not move to one of the end stops.

---

5. Fasten the follower pin (2) in the assigned lever bore (pin position) as listed in the table. Only use the longer follower pin (2) included in the mounting kit.
6. Place lever (1) on the positioner shaft and screw tight using the disk spring (1.2) and nut (1.1).
7. Place positioner on the NAMUR bracket in such a manner that the follower pin (2) rests in the slot of the follower plate (3, 3.1). Adjust the lever (1) correspondingly.
   Screw the positioner to the NAMUR bracket using both fixing screws.



1	Lever
1.1	Nut
1.2	Disk spring
2	Follower pin
3	Follower plate
3.1	Follower plate
6	Connecting plate
6.1	Seal rings
7	Pressure gauge bracket
8	Pressure gauge mounting kit
9	Stem connector
9.1	Bracket
10	NAMUR bracket
11	Screw
14	Bolt
14.1	Screw
15	U-bolt
16	Bracket

Note: *Always use the connecting plate (6) included in the accessories to connect supply and output. Never screw threaded parts directly into the housing.*

Fig. 6 · Attachment according to IEC 60534-6 (NAMUR)

4.3 Attachment to Type 3510 Micro-flow Valve with Type 3271-5 Actuator

Refer to Table 4 on page 42 for the required mounting parts and accessories.
Note the travel table on page 21!

The positioner is attached to the valve yoke using a bracket.

1. Place clamp (3) on the valve stem connector, align at a right angle and screw tight.
2. Screw bracket (10) to the valve yoke using two screws (11).
3. Mount connecting plate (6) or pressure gauge bracket (7) with pressure gauges to the positioner, making sure both seal rings (6.1) are seated properly.

NOTICE
The lever must be held stationary in the mid position while undoing or fastening the nut to ensure that the lever does not move to one of the end stops.

---

4. Unscrew the standard installed lever **M** (1) including follower pin (2) from the positioner shaft.
5. Take lever **S** (1) and screw follower pin (2) in the bore for pin position **17**.
6. Place lever S on the positioner shaft and screw tight using the disk spring (1.2) and nut (1.1).
7. Place positioner on the bracket (10) in such a manner that the follower pin slides into the groove of the clamp (3).

Adjust the lever (1) correspondingly. Screw the positioner to the bracket (10) using both screws.

1 Lever
1.1 Nut
1.2 Disk spring
2 Follower pin
3 Clamp
6 Connecting clamp
6.1 Seal rings
7 Pressure gauge bracket
8 Pressure gauge mounting kit
10 Bracket
11 Screw

Note: *Always use the connecting plate (6) included in the accessories to connect supply and output.*
Never screw threaded parts directly into the housing.

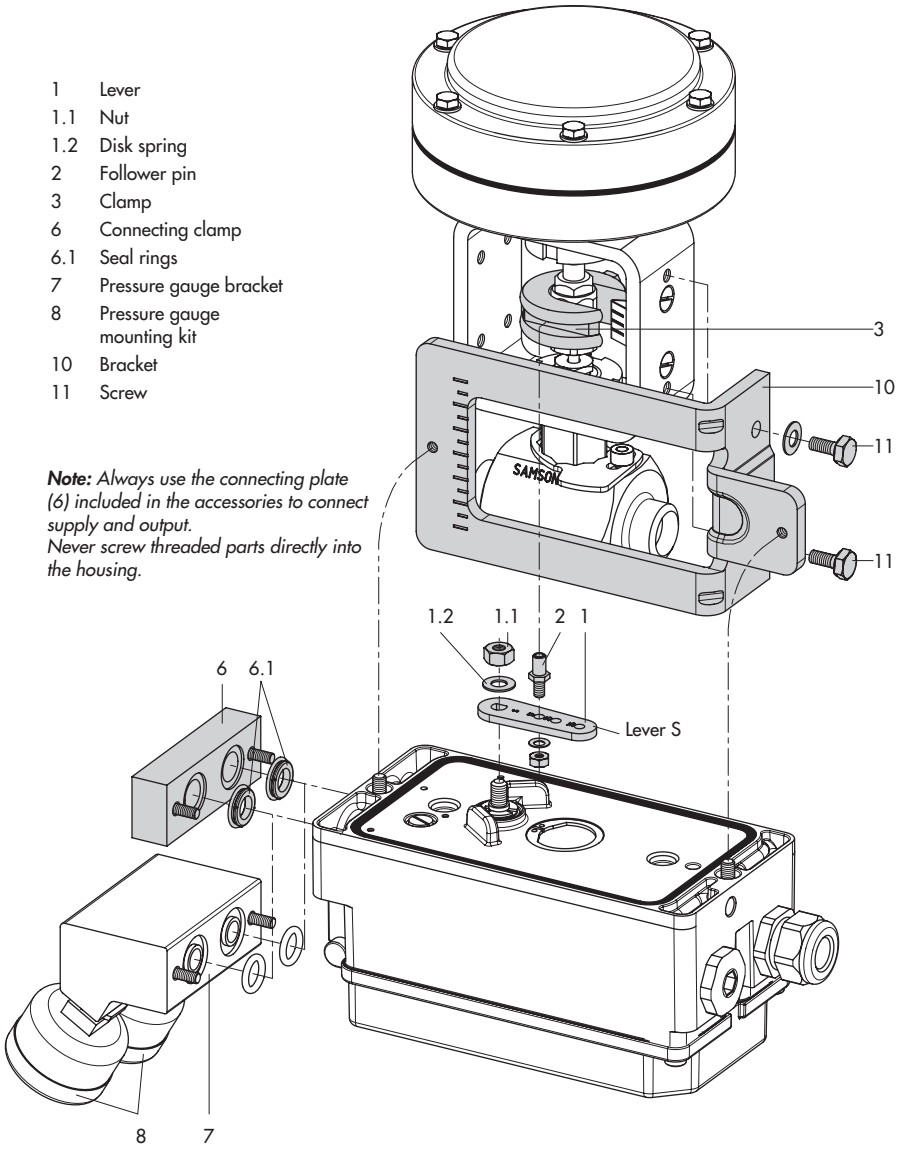


Fig. 7 · Attachment to Type 3510 Micro-flow Valve

4.4 Attachment to rotary actuators

Refer to Table 5 on page 43 for the required mounting parts and accessories.
Note the travel table on page 21!

The positioner is mounted to the rotary actuator using two pairs of brackets.

Prior to attaching the positioner to the SAMSON Type 3278 Rotary Actuator, mount the associated adapter (5) to the free end of the rotary actuator shaft.

Note: *On attaching the positioner as described below, it is imperative that the actuator's direction of rotation is observed.*

---

1. Place follower clamp (3) on the slotted actuator shaft or the adapter (5).
2. Place coupling wheel (4) with flat side facing the actuator on the follower clamp (3). Refer to Fig. 9 to align slot so that it matches the direction of rotation when the valve is in its closed position.
3. Screw coupling wheel and follower clamp tightly onto the actuator shaft using screw (4.1) and disk spring (4.2).
4. Screw the bottom pair of brackets (10.1) with the bends pointing either to the inside or to the outside (depending on the actuator size) to the actuator case. Position top pair of brackets (10) and screw tight.
5. Mount connecting plate (6) or pressure gauge bracket (7) with pressure gauges to the positioner, making sure both O-rings are seated properly.
   For **double-acting**, springless rotary actuators, a reversing amplifier is required to attach the positioner to the actuator, see section 4.5.
6. Unscrew the standard follower pin (2) from the positioner's lever **M** (1). Use the metal follower pin (Ø5) included in the mounting kit and screw tight into the bore for pin position **90**°.
7. Place positioner on the top pair of brackets (10) and screw tight. Considering the actuator's direction of rotation, adjust lever (1) so that it engages in the slot of the coupling wheel (4) with its follower pin (see Fig. 9). It must be guaranteed that the lever (1) is parallel to the long side of the positioner when the actuator is at half its angle of rotation.
8. Stick scale plate (4.3) on the coupling wheel so that the arrow tip indicates the closed position, and it can be easily read when the valve is installed.

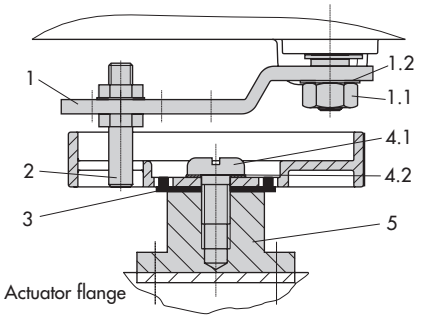
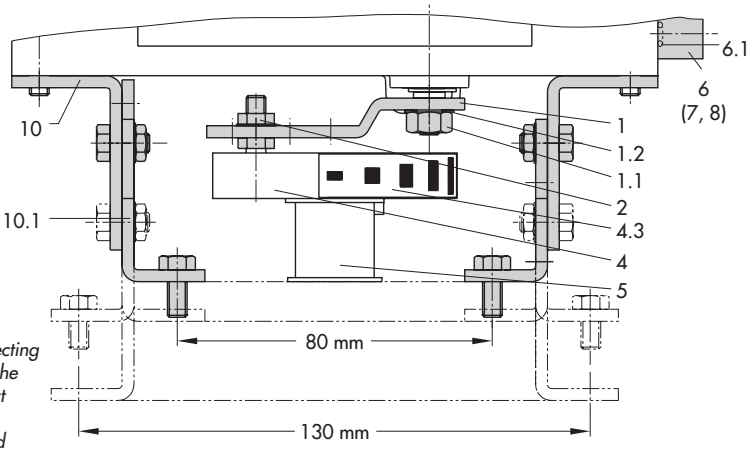
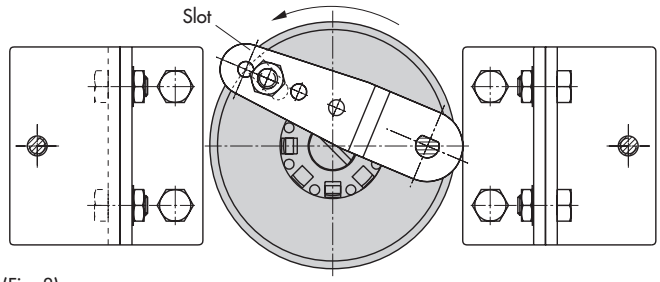
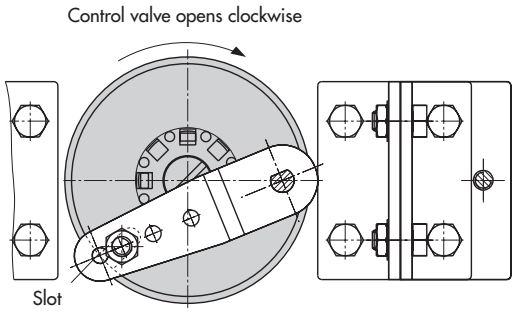


Fig. 8 · Mounting the coupling wheel with Type 3278



Note:
Always use the connecting plate (6) included in the accessories to connect supply and output. Never screw threaded parts directly into the housing.





Legends Figs. 8 + 9

1	Lever
1.1	Nut
1.2	Disk spring
2	Follower pin
3	Follower clamp (Fig. 8)
4	Coupling wheel
4.1	Screw
4.2	Disk spring
4.3	Scale plate
4.3	Scale plate
5	Actuator shaft Adapter for Type 3278
6.1	Seal rings
7	Pressure gauge bracket
8	Pressure gauge mounting kit
10	Top pair of brackets
10.1	Bottom pair of brackets

Fig. 9 · Attachment to rotary actuators

4.4.1 Heavy-duty version

Refer to Table 4 on page 42 for the required mounting parts and accessories.

Both mounting kits contain all the necessary mounting parts. First select correct actuator size. Prepare actuator, and mount required adapter supplied by the actuator manufacturer, if necessary.

1. Mount the housing (10) onto the rotary actuator. In case of VDI/VDE attachment, place spacers (11) underneath, if necessary.
2. **For SAMSON Type 3278 and VETEC S160 Rotary Actuator**, screw the adapter (5) onto the free end of the shaft or place adapter (5.1) onto the shaft of the **VETEC R Actuator.** Place adapter (3) onto **Type 3278, VETEC S160 and VETEC R Actuator**. For **VDI/VDE version**, this step depends on the actuator size.
3. Stick adhesive label (4.3) onto the coupling wheel in such a manner that the yellow part of the sticker is visible in the window of the housing when the valve is OPEN. Adhesive labels with explanatory symbols are enclosed and can be stuck on the housing, if required.
4. Screw tight coupling wheel (4) onto the slotted actuator shaft or adapter (3) using screw (4.1) and disk spring (4.2).
5. Undo the standard follower pin (2) on the lever M (1) of the positioner. Attach the follower pin (Ø 5) included in the mounting kit to pin position 90°.
6. If applicable, mount pressure gauge bracket (7) with pressure gauges or, in case G ¼ threaded connections are required, the connecting plate (6), making sure both seal rings (6.1) are seated properly.
   For double-acting, springless rotary actuators, a reversing amplifier is required to attach the positioner to the actuator. Refer to section 4.5.
7. Place positioner on housing (10) and screw it tight. Considering the actuator's direction of rotation, align lever (1) so that it engages in the correct slot of the coupling wheel with its follower pin (Fig. 10).

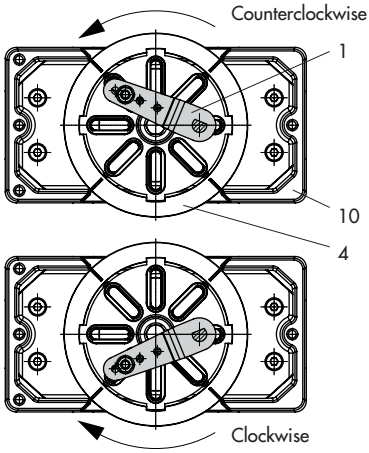
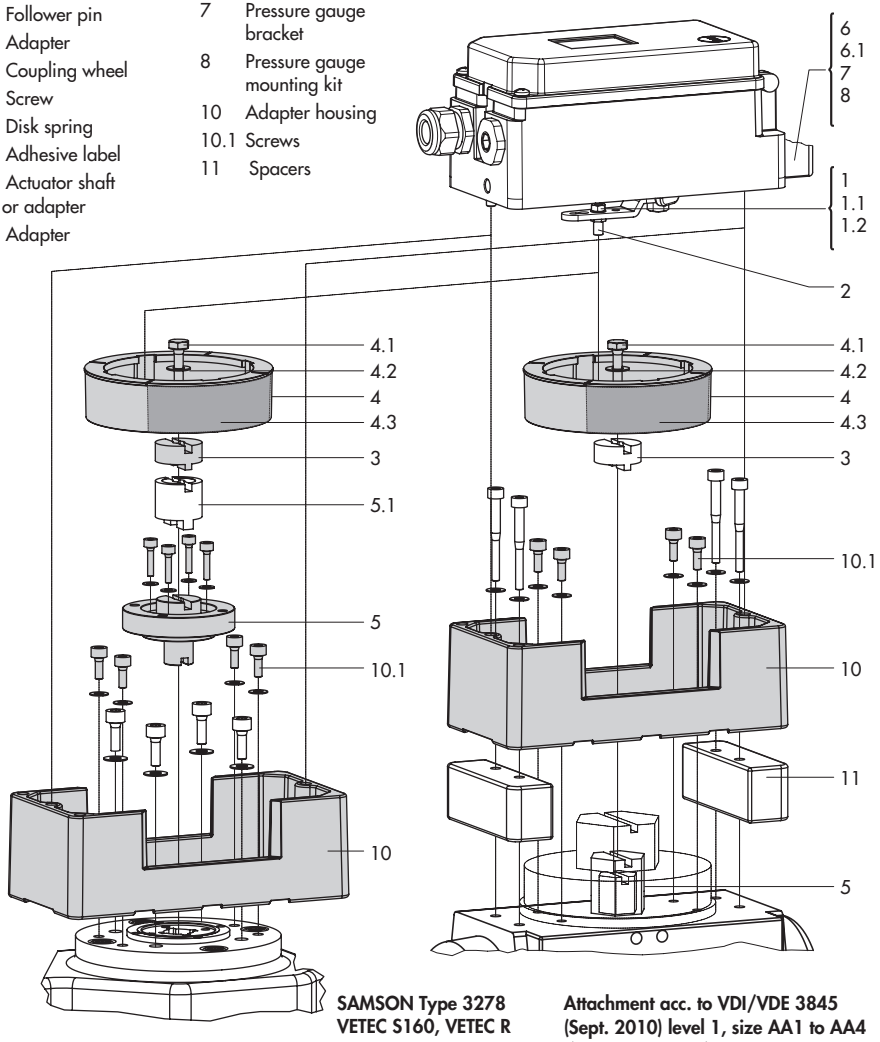


Fig. 10 · Direction of rotation

1 Lever
1.1 Nut
1.2 Disk spring
2 Follower pin
3 Adapter
4 Coupling wheel
4.1 Screw
4.2 Disk spring
4.3 Adhesive label
5 Actuator shaft or adapter
5.1 Adapter
6 Connecting plate (only for G ¼)
6.1 Seal rings
7 Pressure gauge bracket
8 Pressure gauge mounting kit
10 Adapter housing
10.1 Screws
11 Spacers



SAMSON Type 3278
VETEC S160, VETEC R

Attachment acc. to VDI/VDE 3845 (Sept. 2010) level 1, size AA1 to AA4 (see section 15.1)

Fig. 11 · Attachment to rotary actuators (heavy-duty version)

4.5 Reversing amplifier for double-acting actuators

For the use with double-acting actuators, the positioner must be fitted with a reversing amplifier, e.g. the SAMSON Type 3710 Reversing Amplifier (see Mounting and Operating Instructions EB 8392 EN).

4.6 Attaching an external position sensor

Refer to Table 7 on page 44 for the required mounting parts and accessories.

In the positioner version with an external position sensor, the sensor placed in a separate housing is attached over a plate or bracket to the control valve. The travel pick-off corresponds to that of a standard device.
The positioner unit can be mounted as required to a wall or a pipe.

Fig. 12 · Positioner unit with sensor mounted on a micro-flow valve

For the pneumatic connection either a connecting plate (6) or a pressure gauge bracket (7) must be fixed to the housing, depending on the accessories chosen. Make sure the seal rings (6.1) are correctly inserted (see Fig. 6 on page 27, bottom right).

For the electrical connection a 10 meter connecting lead with M12x1 connectors is included in the scope of delivery.

Note:
- *In addition, the instructions in sections 5.1 and 5.2 apply for the pneumatic and electrical connection.*
  Operation and setting are described in sections 7 and 8.
- *Since 2009, the back of the position sensor (20) is fitted with two pins acting as mechanical stops for the lever (1). If this position sensor is mounted using old mounting parts, two corresponding Ø 8 mm holes must be drilled into the mounting plate/bracket (21).*

4.6.1 Mounting the position sensor with direct attachment

Type 3277-5 Actuator with 120 cm²

The signal pressure from the positioner is routed over the signal pressure connection of the connecting plate (9, Fig. 13 left) to the actuator diaphragm chamber. To proceed, first screw the connecting plate (9) included in the accessories onto the actuator yoke.

- Turn the connecting plate (9) so that the correct symbol for the fail-safe position "Actuator stem extends" or "Actuator stem retracts" is aligned with the marking (Fig. 13, below).
- Make sure that the gasket for the connecting plate (9) is correctly inserted.
- The connecting plate has boreholes with NPT and G threads.
  Seal the threaded connection that is not used with the rubber seal and square plug.

Type 3277 Actuator with 240 to 700 cm²

The signal pressure is routed to the connection at the side of the actuator yoke for the version "Actuator stem extends".
For the fail-safe position "Actuator stem retracts" the connection on the top diaphragm case is used. The connection at the side of the yoke must be fitted with a venting plug (accessories).

Mounting the position sensor

1. Place the lever (1) on the sensor in mid-position and hold it in place. Unthread the nut (1.1) and remove the lever together with the disk spring (1.2) from the sensor shaft.
2. Screw the position sensor (20) onto the mounting plate (21).
3. Depending on the actuator size and rated valve travel, determine the required lever and position of the follower pin (2) from the travel table on page 21.
   The positioner is delivered with lever **M** in pin position **35** on the sensor. If necessary, remove the follower pin (2) from its pin position and move it to the borehole for the recommended pin position and screw tight.
4. Place the lever (1) and disk spring (1.2) on the sensor shaft.

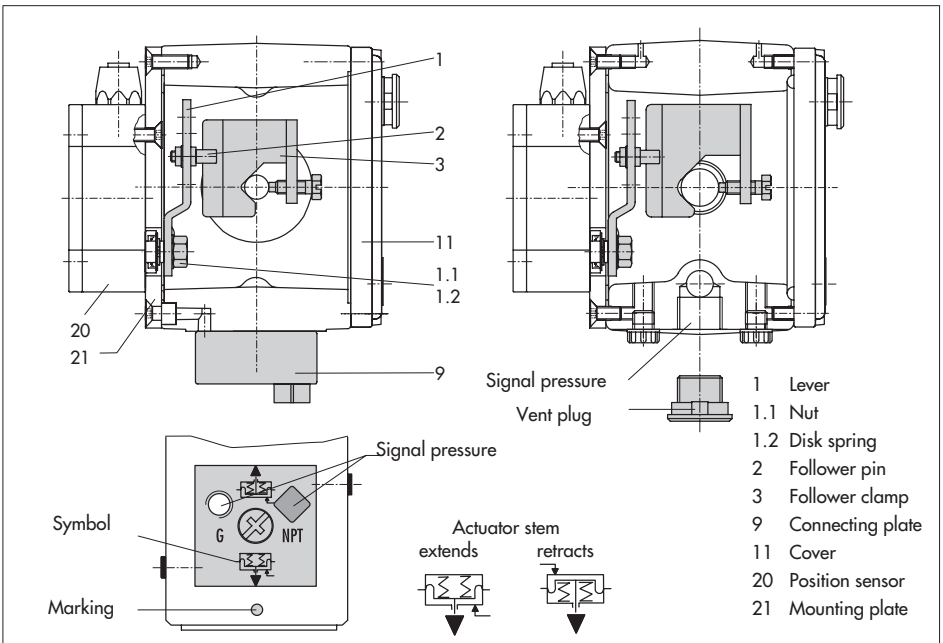


Fig. 13 · Mounting for Type 3277-5 Actuator (left) and Type 3277 Actuator (right)

Place the lever (1) **in mid-position** and **hold it in place**. Screw on the nut (1.1).

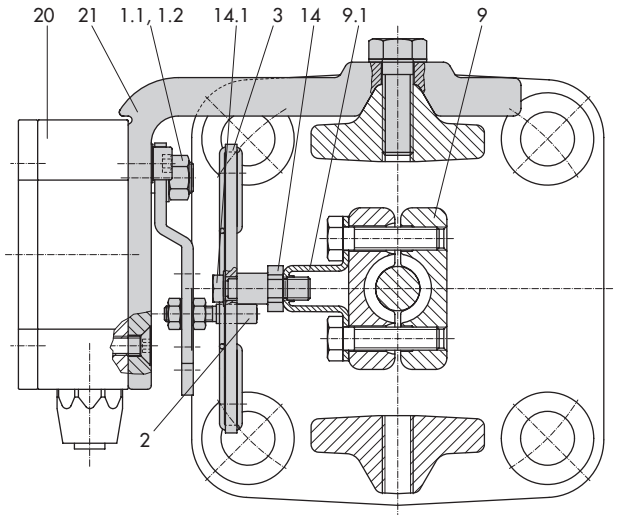
5. Place the follower clamp (3) on the actuator stem, align and fasten it, making sure that the fastening screw rests in the groove of the actuator stem.
6. Place the mounting plate (21) together with the sensor onto the actuator yoke so that the follower pin (2) rests on the top of the follower clamp (3). It must rest on it with spring force.
   Screw tight the mounting plate (21) onto the actuator yoke using both fixing screws.
7. Mount cover (11) on the other side. Make sure that the vent plug points downwards when the control valve is installed to allow any condensed water that collects to drain off.

4.6.2 Mounting the position sensor with attachment according to IEC 60534-6

For the required mounting parts and accessories, refer to Table 7 on page 44.

1. Place the lever (1) on the sensor **in mid-position** and **hold it in place**. Unthread the nut (1.1) and remove the lever together with the disk spring (1.2) from the sensor shaft.
2. Screw the position sensor (20) onto the bracket (21).

The standard attached lever **M** with the follower pin (2) at position **35** is designed for 120, 240 and 350 cm² actuators with 15 mm rated travel.



1 Lever
1.1 Nut
1.2 Disk spring
2 Follower pin
3 Follower plate
9 Stem connector
9.1 Bracket
14 Bolt
14.1 Screws
20 Position sensor
21 Bracket

Fig. 14 · Mounting according to IEC 60534-6 (NAMUR)

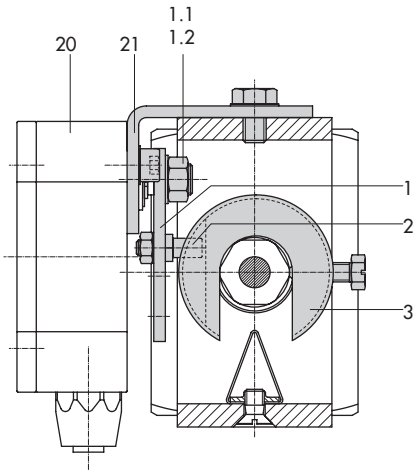
For other actuator sizes or travels, select the lever and pin position from the travel table on page 21. Lever **L** and **XL** are included in the mounting kit.

3. Place the lever (1) and disk spring (1.2) on the sensor shaft.
   Place the lever (1) **in mid-position** and **hold it in place**. Screw on the nut (1.1).
4. Screw both bolts (14) to the bracket (9.1) of the stem connector (9). Attach the follower plate (3) and fix with the screws (14.1).
5. Place the bracket with the sensor at the NAMUR rib in such a manner that the follower pin (2) rests in the slot of the follower plate (3), then screw the bracket using its fixing screws onto the valve.

4.6.3 Mounting the position sensor to Type 3510 Micro-flow Valve

For the required mounting parts and accessories, refer to Table 7 on page 44.

1. Place the lever (1) **in mid-position** and **hold it in place**. Unscrew the nut (1.1) and remove the standard attached lever **M** (1) together with the disk spring (1.2) from the sensor shaft.
2. Screw the position sensor (20) onto the bracket (21).
3. Select the lever **S** (1) from the accessories and screw the follower pin (2) into the hole for pin position **17**.
   Place the lever (1) and disk spring (1.2) on the sensor shaft.



1 Lever
1.1 Nut
1.2 Disk spring
2 Follower pin
3 Follower clamp
20 Position sensor
21 Bracket

Fig. 15 · Mounting on a micro-flow valve

Place the lever (1) in mid-position and hold it in place. Screw on the nut (1.1).

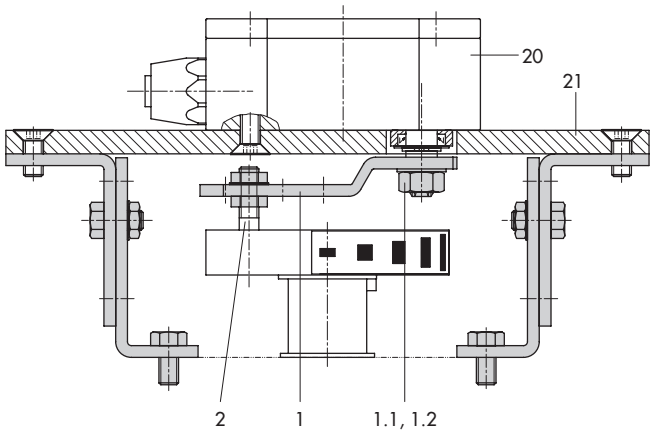
4. Place the follower clamp (3) on the stem connector, align it at a right angle and screw tight.
5. Position the bracket (21) with the position sensor on the valve yoke and screw tight, making sure the follower pin (2) slides into the groove of the follower clamp (3).

4.6.4 Mounting the position sensor to rotary actuators

For the required mounting parts and accessories, refer to Table 7 on page 44.

1. Place the lever (1) **in mid-position** and **hold it in place**. Unscrew the nut (1.1) and remove the standard attached lever **M** (1) together with the disk spring (1.2) from the sensor shaft.
2. Screw the position sensor (20) onto the mounting plate (21).
3. Replace the follower pin (2) normally attached to the lever (1) with the metal follower pin (Ø 5) from the accessories and screw it into the hole for pin position 90°.
4. Place the lever (1) and disk spring (1.2) on the sensor shaft.
   Place the lever (1) **in mid-position** and **hold it in place**. Screw on the nut (1.1).

Follow the instructions describing attachment to the standard positioner in section 4.4 Instead of the positioner, attach the position sensor (20) with its mounting plate (21).



1 Lever
1.1 Nut
1.2 Disk spring
2 Follower pin
20 Position sensor
21 Mounting plate

Fig. 16 · Positioner unit with sensor mounted on rotary actuators

4.7 Mounting the leakage sensor

Normally, the control valve is delivered with positioner and leakage sensor already mounted.

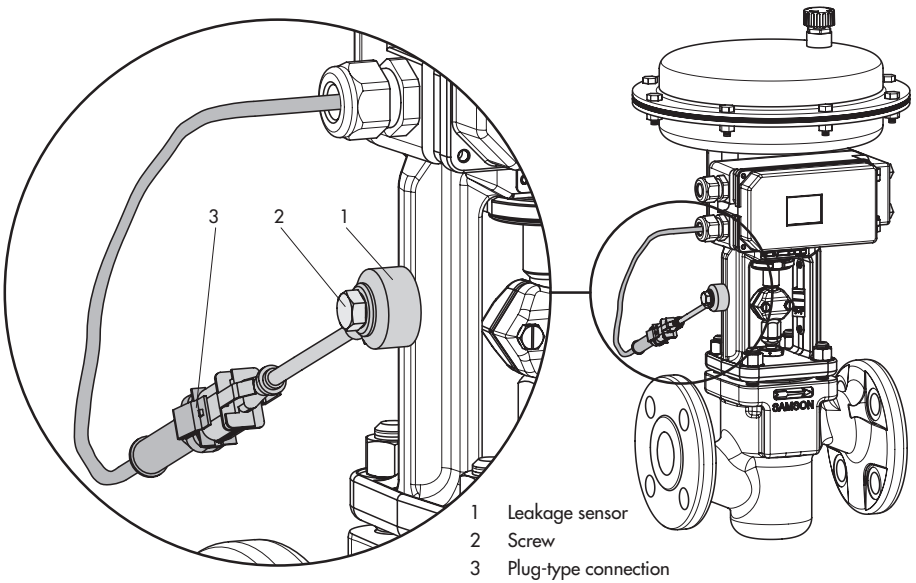
If the leakage sensor is mounted after the valve has been installed or it is mounted onto another control valve, proceed as described in following.

NOTICE
Fasten the leakage sensor using a torque of 20 ±5 Nm.

The hole with M8 thread on the NAMUR rib should preferably be used to mount the sensor (Fig. 17).

Note: *If the positioner was mounted directly onto the actuator (integral attachment), the NAMUR interfaces on either side of the valve yoke can be used to mount the leakage sensor.*

The start-up of the leakage sensor is described in detail in the Operating Instructions EB 8389-1 EN on EXPERTplus Valve Diagnostics.



1 Leakage sensor
2 Screw
3 Plug-type connection

Fig. 17 · Mounting the leakage sensor

4.8 Attaching positioners with stainless steel housings

Positioners with stainless steel housings require mounting parts that are completely made of stainless steel or free of aluminum.

Note: *The pneumatic connecting plate, pressure gauge bracket and Type 3710 Pneumatic Reversing Amplifier are available in stainless steel (see Table 6 for order numbers).*

The Tables 2 to 6 (pages 41 to 43) apply for attaching positioners with stainless steel housings with the following restrictions:

- **Direct attachment**
  All mounting kits from Tables 2 and 3 can be used. The connection block is not required. The stainless steel version of the pneumatic connecting plate routes the air internally to the actuator.
- **Attachment according to IEC 60534-6 (NAMUR rib or attachment to rod-type yokes)**
  All mounting kits from Table 4 can be used. Connecting plate in stainless steel.
- **Attachment to rotary actuators**
  All mounting kits from Table 5 can be used except for the heavy-duty version. Connecting plate in stainless steel.

4.9 Air purging function for single-acting actuators

The exhaust air from the positioner is diverted to the actuator spring chamber to provide corrosion protection inside the actuator. The following must be observed:

- **Direct attachment to Type 3277-5 (stem extends FA/stem retracts FE)**
  The air purging function is automatically provided.
- **Direct attachment to Type 3277, 240 to 700 cm²**
  FA: Remove the stopper 12.2 (Fig. 5 on page 25) at the connection block and make a pneumatic connection to the spring chamber on the vented side.

NOTICE
The method described does not apply to old connection blocks in powder-paint-coated aluminum.
In this case, follow the instructions for attachment described below in "Attachment acc. to IEC 60534-6 (NAMUR rib or attachment to rod-type yokes) and to rotary actuators".

  FE: The air purging function is automatically provided.
- **Attachment acc. to IEC 60534-6 (NAMUR rib or attachment to rod-type yokes) and to rotary actuators**
  The positioner requires an additional port for the exhaust air that can be connected over piping. An adapter available as an accessory is used for this purpose. See Table 6.

NOTICE
*The adapter uses one of the M20 x 1.5 connections in the housing which means **just one** cable gland can be installed.*

Should other valve accessories be used which vent the actuator (e.g. solenoid valve, volume booster, quick exhaust valve), this exhaust air must also be included in the purging function. The connection over the adapter at the positioner must be protected with a check valve, e.g. check valve G ¼ (order no. 8502-0597) mounted in the piping. Otherwise the pressure in the positioner housing would rise above the ambient pressure and damage the positioner when the exhausting components respond suddenly.

4.10 Required mounting parts and accessories

Table 2 · Direct attachment to Type 3277-5 Actuator (Fig. 4)			Order no.
Mounting parts	Mounting parts for actuators 120 cm² or smaller		1400-7452
Accessories for the actuator	Connecting plate (9) (**new**) for Actuator Type 3277-5xxxxxx.**01** (new) [1], G ¼ and ¼ NPT		1400-6823
	Connecting plate (**old**) for Actuator Type 3277-5xxxxxx.**00** (old): G ¼		1400-6820
	Connecting plate (**old**) for Actuator Type 3277-5xxxxxx.**00** (old): G ¼		1400-6821
Accessories for the positioner	Connecting plate (6)	G ¼	1400-7461
		¼ NPT	1400-7462
	Pressure gauge bracket (7)	G ¼	1400-7458
		¼ NPT	1400-7459
	Pressure gauge mounting kit (8) up to max. 6 bar (output/supply)	St. steel/brass	1400-6950
		St. steel/St. st.	1400-6951

[1] Only new switchover and connecting plates can be used with new actuators (Index 01). Old and new plates are **not** interchangeable.

Table 3 · Direct attachment to Type 3277 (Fig. 5)				Order no.
Mounting parts	For actuators with 240, 350, 355 and 700 cm²			1400-7453
Accessories	Required piping with screw fitting – for "Actuator stem retracts" – with air purging of the top diaphragm chamber	240 cm²	Steel	1400-6444
			Stainless steel	1400-6445
		350 cm²	Steel	1400-6446
			Stainless steel	1400-6447
		355 cm²/ 700 cm²	Steel	1400-6448
			Stainless steel	1400-6449
	Connection block with seals and screw		G ¼	1400-8819
			¼ NPT	1400-8820
	Pressure gauge mounting kit (8) up to max. 6 bar (output/supply)		St. st./Brass	1400-6950
			St. st./St. st.	1400-6951

Table 4 · Attachment to NAMUR ribs or control valves with rod-type yokes (20 to 35 mm rod diameter) according to IEC 60534-6 (Figs. 6 and 7)				Order no.
Travel in mm	**Lever**	**For actuators**		
7.5	S	Type 3271-5 Actuator with 60/120 cm² on Type 3510 Valve (Fig. 7)		1400-7457
5 to 50	M [1]	Actuators from other manufacturers and Type 3271with 120 to 700 cm²		1400-7454
14 to 100	L	Actuators from other manufacturers and Type 3271, versions 1000 and 1400-60		1400-7455
40 to 200	XL	Actuators from other manufacturers and Type 3271, versions 1400-120 and 2800 cm² with 120 mm travel		1400-7456
30 or 60	L	Type 3271, versions 1400-120 and 2800 cm² (30 or 60 mm travel)		1400-7466
		Mounting bracket for Emerson and Masoneilan linear actuators; a mounting kit acc. to IEC 60534-6 is necessary depending on the travel (see above)		1400-6771
		Valtek Type 25/50		1400-9554
Accessories	Connecting plate (6)		G ¼	1400-7461
			¼ NPT	1400-7462
	Pressure gauge bracket (7)		G ¼	1400-7458
			¼ NPT	1400-7459
	Pressure gauge mounting kit (8) up to max. 6 bar (output/supply)		St. st./Brass	1400-6950
			St. steel/St. st.	1400-6951

[1] Lever M is mounted on the standard positioner (included in the scope of delivery)

Table 5 · Attachment to rotary actuators (Figs. 8 and 9)			Order no.
Mounting parts	Attachment acc. to VDI/VDE 3845 (September 2010), refer to section 15.1 for details		
	Actuator surface corresponds to level 1		
	Size AA1 to AA4, version with CrNiMo steel bracket		1400-7448
	Size AA1 to AA4, heavy-duty version		1400-9244
	Heavy-duty version (e.g. Air Torque 10 000)		1400-9542
	Bracket surface corresponds to level 2, heavy-duty version		1400-9526
	Attachment for SAMSON Type 3278 with 160/320 cm², CrNiMo steel bracket		1400-7614
	Attachment for SAMSON Type 3278 with 160 cm² and for VETEC Type S160, Type R and Type R, heavy-duty version		1400-9245
	Attachment for SAMSON Type 3278 with 320 cm² and for VETEC Type S320, heavy-duty version		1400-5891 and 1400-9526
	Attachment to Camflex II		1400-9120
Accessories	Connecting plate (6)	G ¼	1400-7461
		¼ NPT	1400-7462
	Pressure gauge bracket (7)	G ¼	1400-7458
		¼ NPT	1400-7459
	Pressure gauge mounting kit up to max. 6 bar (output/supply)	St. steel/brass	1400-6950
		St. steel/st. steel	1400-6951

Table 6 · General accessories			Order no.
Accessories	Pneumatic reversing amplifier for double-acting actuators		Type 3710
	Cable gland M20 x 1.5, nickel-plated brass		1890-4875
	Adapter M 20 x 1.5 to ½ NPT, aluminum		0310-2149
	Retrofit kit for inductive limit switch 1x SJ 2-SN		1400-7460
	Cover plate with list of parameters and operating instructions	German/English (standard)	1990-0761
		English/Spanish	1990-3100
		English/French	1990-3142
	TROVIS-VIEW with device module 3730-3 (order no. 6661-1056)		1043732
	Serial interface adapter (SAMSON SSP interface - RS-232 port on computer)		1400-7700
	Isolated USB interface adapter (SAMSON SSP interface - USB port on computer) including TROVIS-VIEW CD-ROM		1400-9740
Positioner with stainless steel housing	Connecting plate (stainless steel)	G ¼	1400-7476
		¼ NPT	1400-7477
	Pressure gauge bracket (stainless steel)	Only in ¼ NPT	1400-7108
Air purging function	Adapter with threaded bushing (M20 x 1.5) for attachment acc. to IEC 60534-6 (NAMUR rib or attachment to rod-type yoke) and to rotary actuators	G ¼	0310-2619
		¼ NPT	0310-2550

Table 7 · Attachment of external position sensor			Order no.
Direct attachment	Mounting parts for actuators with 120 cm² see Fig. 13 left		1400-7472
	Connecting plate (9, old) for Actuator Type 3277-5xxxxxx.**00**	G ⅛	1400-6820
		⅛ NPT	1400-6821
	Connecting plate (new) for Actuator Type 3277-5xxxxxx.**01** (new) [1]		1400-6823
	Mounting parts for actuators with 240, 350, 355 and 700 cm², see Fig. 13 right		1400-7471
NAMUR attachmt.	Mounting parts for attachment to NAMUR rib with lever L and XL, see Fig. 14		1400-7468
Micro-flow valve	Mounting parts for Type 3510 Micro-flow Valve, see Fig. 15		1400-7469
Attachment to rotary actuators	VDI/VDE 3845 (September 2010), refer to section x for details		
	Actuator surface corresponds to level 1 Size AA1 to AA4 with follower clamp and coupling wheel, version with CrNiMo steel bracket, see Fig. 16 Size AA1 to AA4, heavy-duty version Size AA5, heavy-duty version (e.g. Air Torque 10 000)		1400-7473 1400-9384 1400-9992
	Bracket surface corresponds to level 2, heavy-duty version		1400-9974
	SAMSON Type 3278 with 160 cm² (also for VETEC Type S160 and Type R), heavy-duty version		1400-9385
	SAMSON Type 3278 with 320 cm² and for VETEC Type S320, heavy-duty version		1400-5891 and 1400-9974
Accessories for positioner	Connecting plate (6)	G ¼	1400-7461
		¼ NPT	1400-7462
	Pressure gauge bracket (7)	G ¼	1400-7458
		¼ NPT	1400-7459
	Pressure gauge mounting kit up to max. 6 bar (output/supply)	St. steel/brass	1400-6950
		St. steel/st. steel	1400-6951
	Bracket to mount the positioner on a wall **Note:** The other fastening parts are to be provided at the site of installation as wall foundations vary from site to site.		0309-0111

[1] Only new switchover and connecting plates can be used with new actuators (Index 01). Old and new plates are **not** interchangeable.

5 Connections

WARNING!
Mount the positioner, keeping the following sequence:
1. Mount the positioner on the control valve
2. Connect the supply air
3. Connect the electrical power
4. Perform the start-up settings

The connection of the electrical auxiliary power may cause the actuator stem to move, depending on the operating mode.
Do not touch the actuator stem or obstruct it to avoid risk of injury to hands or fingers.

5.1 Pneumatic connections

NOTICE
Follow the instructions below to avoid damaging the positioner.
- *The threaded connections in the positioner housing are not designed direct air connection!*
- *The screw glands must be screwed into the connecting plate, the pressure gauge mounting block or the connection block from the accessories.*
  The air connections are optionally designed as a bore with ¼ NPT or G ¼ thread.
  The customary fittings for metal and copper pipes or plastic hoses can be used.
- *The supply air must be dry and free from oil and dust.*
  The maintenance instructions for upstream pressure reducing stations must be observed.

If the positioner is attached directly to the Type 3277 Actuator, the connection of the positioner's output pressure to the actuator is fixed. For attachment according to IEC 60534-6 (NAMUR), the signal pressure can be routed to either the top or bottom diaphragm chamber of the actuator, depending on the actuator's fail-safe action "Actuator stem extends" or "Actuator stem retracts".
For rotary actuators, the manufacturer's specifications for connection apply.

5.1.1 Signal pressure gauges

To monitor the supply air (Supply) and signal pressure (Output), we recommend that pressure gauges be attached (see accessories in Tables 2 to 6).

5.1.2 Supply pressure

The required supply air pressure depends on the bench range and the actuator's operating direction (fail-safe action).
The bench range is registered on the nameplate either as spring range or signal pressure range depending on the actuator. The direction of action is marked **FA** or **FE**, or by a symbol.

Note: *If the supply pressure p_s is lower than the upper spring range value detected during plotting of the valve signature, PLOW is indicated under* ***Code 0****.*

Actuator stem extends FA (air to open)

Fail-safe position "Valve closed"
(for globe and angle valves):

Actuator stem retracts FE (air to close)

Fail-safe position "Valve open"
(for globe and angle valves):
For tight-closing valves, the maximum signal pressure pst_{max} is roughly estimated as follows:

$$pst_{max} = F + \frac{d^2 \cdot \pi \cdot \Delta p}{4 \cdot A} \text{ [bar]}$$

d = Seat diameter [cm]
Δp = Differential pressure across the valve [bar]
A = Actuator diaphragm area [cm^2]
F = Upper bench range value [bar]

If there are no specifications, calculate as follows:

Required supply pressure =
Upper bench range value + 1 bar.

5.1.3 Signal pressure (output)

The signal pressure at the output (Output 38) of the positioner can be limited in steps of 0.1 bar to a pressure between 1.4 and 7.0 bar in **Code 16**.

The limitations is not activated [7.0 bar] by default.

5.2 Electrical connections

DANGER!
Risk of electric shock and/or the formation of an explosive atmosphere!

– *For electrical installation, observe the relevant electrotechnical regulations and the accident prevention regulations that apply in the country of use.*

NOTICE
– *Adhere to the terminal assignment!*
– *Switching the assignment of the electrical terminals may cause the explosion protection to become ineffective!*
– *Do not loosen enameled screws in or on the housing.*
– *The maximum permissible values specified in the national EC type examination certificates apply when interconnecting intrinsically safe electrical equipment (U_i or U_o; I_i or I_o; P_i or P_o; C_i or C_o, and L_i or L_o).*

Selecting cables and wires:
For installing intrinsically safe circuits, observe ***Paragraph 12 in EN 60079-14: 2008 (VDE 0165 Part 1)***.
To install and select cables and wires as well as to run several intrinsically safe circuits in one multi-core cable, observe the installation regulations valid in the country of use. The diameter of an individual wire in a fine-stranded conductor must not be smaller than 0.1 mm. Protect the conductor ends against splicing, e.g. by using wire-end ferrules.
When two separate cables are used for con-

nection, an additional cable gland can be installed.
Seal cable entries left unused with plugs. Devices used at ambient temperatures ***below –20 °C*** *must be fitted with metal cable glands.*

Equipment for use in zone 2/zone 22
In equipment operated with type of protection EEx nA II (non-sparking equipment) according to EN 60079-15 (2003), circuits may be connected, interrupted or switched while energized only during installation, maintenance or repair.

Equipment connected to energy-limited circuits with type of protection Ex nL (energy-limited equipment) according to EN 60079-15 (2003) may be switched under normal operating conditions.

The maximum permissible values specified in the national explosion protection certificates also apply when interconnecting the equipment with energy-limited circuits in type of protection Ex nL IIC/IIB.

Cable entries
The cable entry with M20 x 1.5 cable gland, 6 to 12 mm clamping range.
There is a second M20 x 1.5 threaded bore in the housing that can be used for additional connection, when required.
The screw terminals are designed for wire cross-sections of 0.2 to 2.5 mm². Tighten by at least 0.5 Nm.

The wires for the reference variable must be connected to the terminals 11 and 12 located in the housing.

Only use **a current source**!

≥ 3.6 mA: Microprocessor and display active

< 3.7 mA: ***LOW*** on display

≤ 3.8 mA: Emergency shutdown

> 3.9 mA: Actuator can be filled with air

> 22 mA: ***OVERLOAD*** on display

In general, it is not necessary to connect the positioner to a bonding conductor. Should this be required, however, this conductor can be connected inside the device.
Depending on the version, the positioner is equipped with inductive limit switches and/or a solenoid valve.
The position transmitter is operated on a two-wire circuit. The usual supply voltage is 24 V DC. Considering the resistance of the supply leads, the voltage at the position transmitter terminals can be between 12 V and 30 V DC.
Refer to Fig. 18 or the label on the terminal strip for terminal assignment.

Accessories:
Plastic cable gland M20 x 1.5:
– black Order no. 8808-1011
– blue Order no. 8808-1012
– Brass, nickel-pl. Order no. 1890-4875
– St. steel 1.4305 Order no. 8808-0160

Adapter M20 x 1.5 to ½ NPT
– Aluminum, powder-coated
Order no. 0310-2149
– Stainless steel Order no. 1400-7114

5.2.1 Switching amplifiers

For operation of the limit switches, switching amplifiers must be connected in the output circuit. To ensure the operational reliability of the positioner, the amplifiers should comply with the limit values of the output circuits conforming to EN 60947-5-6.
If the positioner is to be installed in hazardous areas, the relevant regulations must be observed.

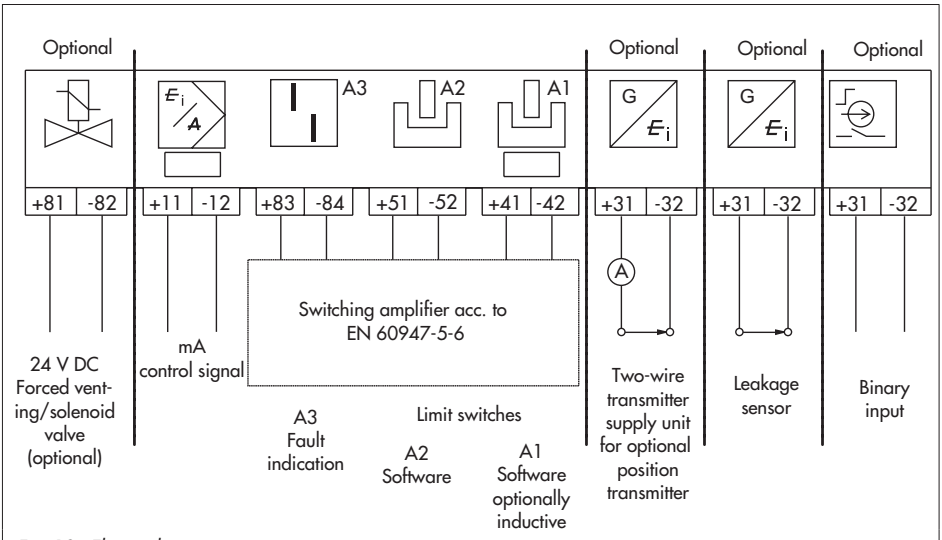


Fig. 18 · Electrical connections

5.2.2 Establishing communication

Communication between PC and positioner (via FSK modem or handheld communicator, if necessary, using an isolation amplifier) is based on the HART® protocol.

Type Viator FSK modem

RS 232	not ex.	Order no. 8812-0130
PCMCIA	not ex	Order no. 8812-0131
USB	not ex	Order no. 8812-0132

If the supply voltage of the controller or control station becomes too low because it has been reduced by the load in the circuit, an isolation amplifier is to be connected between controller and positioner (interfacing as for positioner connected in hazardous areas, see Fig. 19).

If the positioner is used in hazardous areas, an explosion-protected isolating amplifier is to be used.

By means of the HART® protocol, all control room and field devices connected in the loop are individually accessible through their address via point-to-point or standard bus (multidrop).

Point-to-point:

The bus address/polling address must always be set to zero (0).

Standard bus (multidrop):

In the standard bus (multidrop) mode, the positioner follows the analog current signal (reference variable) as for point-to-point communication. This operating mode is, for example, suitable for split-range operation of positioners (series connection). The bus

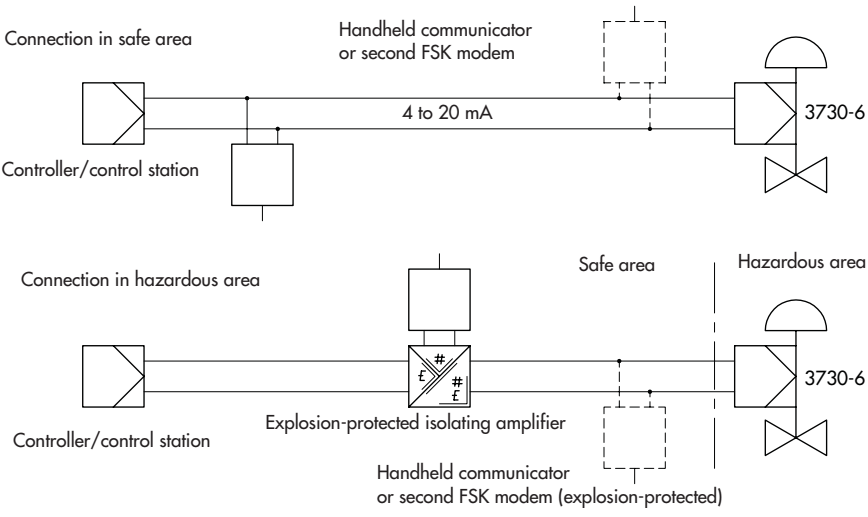


Fig. 19 · Connection with FSK modem

address/polling address has to be within a range of 1 to 15.

Note:
Communication errors may occur when the process controller/control station output is not HART-compatible.
For adaptation, the Z box (order no. 1170-2374) can be installed between output and communication interface.
At the Z box a voltage of 330 mV is released (16.5 Ω at 20 mA).

Alternatively, a 250-Ω resistor can be connected in series and a 22-µF capacitor can be connected in parallel to the analog output.

Note:

- *The load for the controller output will increase as a result.*
- *The insertion of a capacitor is not permissible for intrinsically safe circuits (Ex ia), energy-limited circuits (Ex nL) and for the type of protection Ex nA.*

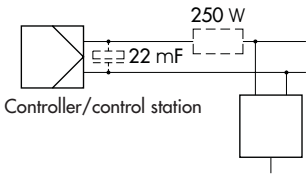


Fig. 20 · Adapting the output signal

6 Operator controls and readings

Rotary pushbutton ⊛

The rotary pushbutton is located underneath the front protective cover.
The positioner is operated on site using the rotary pushbutton:

Turn ⊛ to select codes and values.

Press ⊛ to confirm setting.

Slide switch AIR TO OPEN or AIR TO CLOSE

- AIR TO OPEN applies when the increasing signal pressure opens the valve
- AIR TO CLOSE applies when the increasing signal pressure closes the valve

The signal pressure is the air pressure at the output of the positioner which is transferred to the actuator.
For positioners with an attached reversing amplifier for double-acting rotary actuators (section 4.5): switch position AIR TO OPEN.

Volume restriction Q

The volume restriction is used to adapt the air delivery to the actuator size. Two fixed settings are possible depending on how the air is routed at the actuator:

- For actuators smaller than 240 cm² with a loading pressure connection at the side (Type 3271-5) → MIN SIDE.
- For actuators 240 cm² and larger, select MAX SIDE for a side connection.

Readings on display

Icons appear on the display that are assigned to parameters, codes and functions.

Operating mode:
– Manual mode (see section 8.2.1)
– Automatic mode (see section 8.2.1)
S – SAFE (see section 8.2.2)

- **Bar elements:**
  In manual and automatic modes, the bars indicate the system deviation that depends on the sign (+/–) and the value. One bar element appears per 1 % system deviation.
  If the device has not yet been initialized (blinks on the display), the lever position in degrees in relation to the longitudinal axis is indicated. One bar element corresponds to approximately a 5° angle of rotation.
  If the fifth bar element blinks (reading > 30°), the permissible angle of rotation has been exceeded. Lever and pin position must be checked.
- **Status messages**
  : Failure
  : Maintenance required/Maintenance demanded
  blinks: Out of specification
  These icons indicate that an error has occurred.
  A classified status can be assigned to each error. Classifications include 'No message', 'Maintenance required', 'Maintenance demanded' and 'Failure' (see section 14).
- **Configuration enabled**
  Indicates that codes marked with an asterisk (*) in the code list (section 14) are enabled for configuration (section 8.1).

Displays and their meaning

AUTO	Automatic
CL	Clockwise
CCL	Counterclockwise
Err	Error
ESC	Escape
HI	ix ≥ 21.6 mA
LO	ix ≤ 2.4 mA
LOW	w ≤ 3.7 mA
MAN	Manual
MAX	Maximum range
No	Not available/ Not active
NOM	Nominal travel
OVERLOAD	w > 22 mA
PLOW	p_s lower than upper spring range value
RES	Reset
SAFE	Fail-safe position
SUB	Substitute calibration
TUNE	Initialization in progress
YES	Available/Active
ZP	Zero calibration
0 bar	No supply air
↗↗	Increasing/increasing
↗↘	Increasing/decreasing
blinks	Emergency mode (see **Code 62**)
blinks	Not initialized
S	Valve in mechanical fail-safe position
	Failure
	Maintenance required/demanded
blinks	Out of specification
blinks	Write protection active (over binary input option or HART® communication)

O/C and ***PST*** in alternating sequence: Write protection active (time-controlled PST)

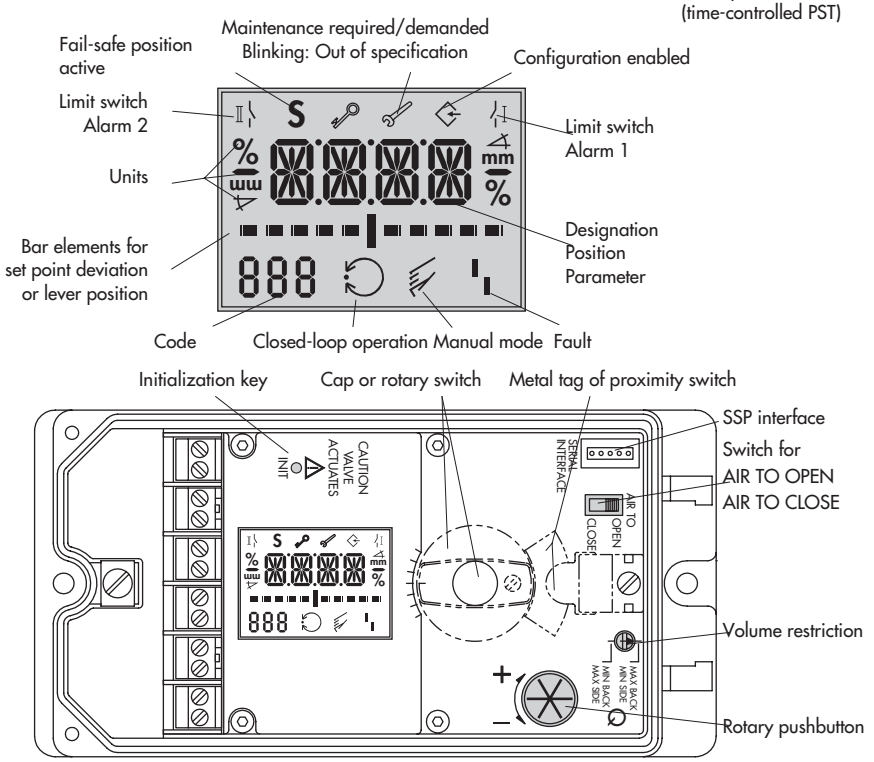


Fig. 21 · Display and operator controls

6.1 Serial interface

The positioner must be supplied with at least 3.8 mA.

The positioner can be connected directly to the PC via the local serial interface and the serial interface adapter.
The operator software is TROVIS-VIEW 4 with installed device module 3730-6.

6.2 HART® communication

The positioner must be supplied with at least 3.6 mA. The FSK modem must be connected in parallel to the current loop.

A DTM file (Device Type Manager) conforming to the Specification 1.2 is available for communication. This allows the device, for example, to be run with the PACTware operator interface. All the positioner's parameters are then accessible over the DTM and the operator interface.

For start-up and settings, proceed as described in section 7.1 to 7.4. Refer to the code list in section 14 for the parameters necessary for the operator interface.

NOTICE
*The write access for HART® communication can be disabled over **Code 47**. You can only disable or enable this function locally at the positioner.*
*The write access is enabled by default. The on-site operation including the INIT key can be locked over HART® communication. The word 'HART' then blinks on the display when **Code 3** is selected. This locking function can only be disabled over HART® communication. On-site operation is enabled by default.*

***Note:** In the case, complex functions are started in the positioner, which require a long calculation time or lead to a large quantity of data being stored in the volatile memory of the positioner, the alert 'busy' is issued by the DTM file.*
*This alert is **not an error message** and can simply be confirmed.*

6.3 Dynamic HART® variables

The HART® specification defines four dynamic variables consisting of a value and an engineering unit. These variables can be assigned to device parameters as required. The universal HART® command 3 reads the dynamic variables out of the device. This allows manufacturer-specific parameters to also be transferred using a universal command.

The dynamic variables of Type 3730-6 can be assigned as follows in TROVIS-VIEW [Device settings > Positioner > HART® communication]:

Table 8 · Assignment of dynamic HART® variables		
Variable	**Meaning**	**Unit**
Set point	Set point	%
Direction of action set point	Direction of action set point	%
Set point after transit time specification	Set point after transit time specification	%
Valve position	Valve position	%
Set point deviation e	Set point deviation e	%
Absolute total valve travel	Absolute total valve travel	–
Binary input status	0 = Not active 1 = Active 255 = –/–	–
Internal solenoid valve/forced venting status	0 = De-energized 1 = Energized 2 = Not installed	–
Condensed state	0 = No message 1 = Maintenance required 2 = Maintenance demanded 3 = Failure 4 = Out of specification 7 = Function check	–
Temperature	Temperature	°C
Leakage sensor sound level	Sound pressure level (leakage sensor)	dB
Ambient pressure	Ambient pressure	mbar
Signal pressure p out	Signal pressure p_{out}	bar
Supply pressure	Supply pressure	bar
Flow rate	Flow rate	m^3/h
Differential pressure	Differential pressure	bar

7 Start-up – Settings

WARNING!
Attach the positioner, keeping the following sequence:
1. Mount the positioner on the control valve
2. Connect the supply air
3. Connect the electrical power
4. Perform the start-up settings

Reading on display after connecting the electrical auxiliary power:

- *The fault alarm icon appears and blinks on the display when the positioner has* **not yet been initialized**. The reading indicates the lever position in degrees in relation to the longitudinal axis.

Reading when the positioner has not yet been initialized

- If **Code 0** appears on the display when a positioner has been **initialized**. The positioner is in the last active operating mode.

WARNING!
The actuator stem moves while the start-up settings are being performed.
Do not touch the actuator stem or obstruct it to avoid risk of injury to hands or fingers.

NOTICE
Perform the start-up settings in the same sequence as listed (section 7.1 to section 7.6).

Note: *The positioner performs a test in the start-up phase while following its automation task at the same time. During the start-up phase, operation on site is unrestricted, yet write access is limited.*

7.1 Defining the valve closed position

Taking into account the valve type and actuator's direction of action, assign the closed position (0 %) by positioning the AIR TO OPEN/CLOSE slide switch:

- **AIR TO OPEN (ATO)** position
  Signal pressure opens the valve, e.g. for valve with fail-close
- **AIR TO CLOSE (ATC)** position
  Signal pressure closes the valve, e.g. for valve with fail-open

NOTICE
The AIR TO OPEN (ATO) setting always applies to double-acting actuators.

For checking purposes:
After successfully completing initialization, the positioner display should read 0 % when the valve is closed and 100 % when the valve is open. If this is not the case, change the slide switch position and re-initialize the positioner.

Note: *The switch position is prompted prior to an initialization. After an initialization has been completed, changing the switch position does not have any effect on the operation of the positioner.*

7.2 Setting the volume restriction Q

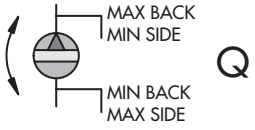


Fig. 22 · Volume restriction Q
MAX BACK/MIN SIDE setting

The volume restriction Q is used to adapt the air delivery to the size of the actuator:

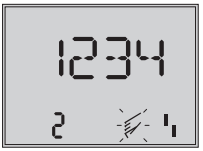
- **MAX BACK/MIN SIDE position** for actuators with a **transit time < 1 s**, e.g. linear actuators with an effective area smaller than 240 cm², require a restricted air flow rate (MIN).
- **MIN BACK/MAX SIDE** position for actuators with a **transit time** ≥ 1 s (the air flow rate does not need to be restricted.)

Intermediate positions are not permitted

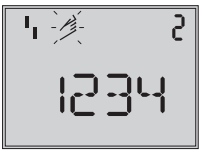
NOTICE
The positioner needs to be initialized again after the position of the restriction has been changed.

7.3 Adapting the display

The data representation on the positioner display can be turned by 180° to adapt it to how the positioner is mounted.



Reading direction for right attachment of pneumatic connections



Reading direction for left attachment of pneumatic connections

If the displayed data appear upside down, proceed as follows:

Turn ⊛ → **Code 2**

Press ⊛, Code 2 blinks

Turn ⊛ → Required direction

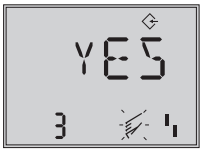
Press ⊛ to confirm reading direction.

7.4 Limiting the signal pressure

If the maximum actuator force may cause damage to the valve, the signal pressure p_{out} must be limited.

Enable configuration at the positioner before activating the pressure limit function:

Note: *If no settings are entered within 120 seconds, the enabled configuration function becomes invalid.*



Configuration enabled
Default: ***No***

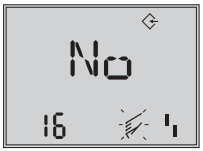
Turn ⊛ → **Code 3**, display: ***No***

Press ⊛, Code 3 blinks

Turn ⊛ → ***YES***

Press ⊛, display ⇉

Limiting the signal pressure:



Pressure limit
Default: ***No***

Turn ⊛→ **Code 16**

Press ⊛, Code 16 blinks

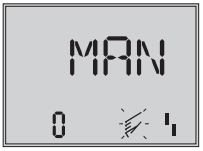
Turn ⊛ until the required pressure limit appears.

Press ⊛ to confirm the pressure limit setting.

7.5 Checking the operating range of the positioner

To check the mechanical attachment and the proper functioning, the valve should be moved through the operating range of the positioner in the ✋ manual operating mode with the manual set point.

Selecting ✋ manual operating mode:



Operating mode
Default ***MAN***

Turn ⊛ → **Code 0**

Press ⊛, Code 0 blinks

Turn ⊛ → ***MAN***

Press ⊛ . The positioner changes to the manual operating mode ✋.

Checking the operating range:

Manual set point
(current angle of rotation is indicated)

Turn ⊛ → **Code 1**

Press ⊛, Code 1 and ✋ blink

Turn ⊛ until the pressure in the positioner builds up, and the control valve moves to its final positions so that the travel/angle of rotation can be checked.
The angle of rotation of the lever on the back of the positioner is indicated. A horizontal lever (mid position) is equal to 0°.

To ensure the positioner is working properly, the outer bar elements may not blink while the valve is moving through the operating range.
Exit **Code 1** by pressing the rotary pushbutton (⊛).

WARNING!
To avoid personal injury or property damage caused by the supply air or electrical auxiliary power, disconnect the supply air and electrical auxiliary power before exchanging the lever or changing the pin position.

7.6 Initialization

WARNING!
During initialization, the control valve moves through its entire travel/angle of rotation range. Therefore, do not start the initialization procedure while a process is running, but only during start-up when all shut-off valves are closed.

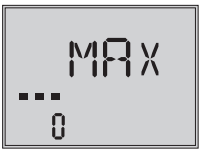
Before starting initialization, check the maximum permissible signal pressure of the control valve. During initialization, the positioner issues an output signal pressure up to the maximum supply pressure supplied. If necessary, limit the signal pressure by connecting an upstream pressure reducing valve.

NOTICE
After the positioner has been mounted on to another actuator or its mounting location has been changed and prior to re-initializing the positioner, the positioner needs to be reset to its basic setting (default values). Refer to section 7.9.

Note: *When the write protection is activated, the initialization cannot be started.*

During initialization the positioner adapts itself optimally to the friction conditions and the signal pressure demand of the control valve. The type and extent of self-adaptation depends on the set initialization mode:

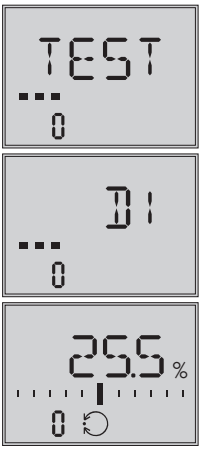
- **Maximum range (*MAX)*** (standard range)
  Initialization mode for simple start-up of valves with two clearly defined mechanical end positions, e.g. three-way valves (see section 7.6.1)
- Nominal range (***NOM)***
  Initialization mode for all globe valves (see section 7.6.2)
- **Manually selected OPEN position (*MAN)***
  Initialization mode for globe valves with manual entry of the OPEN position (see section 7.6.3)
- **Manually selected end positions (*MAN2)***
  Initialization mode for globe valves with manual entry of both positions (see section 7.6.4)
- **Substitute calibration (*SUB)***
  This mode allows a positioner to be replaced while the plant is running, with the least amount of disruption to the plant (see section 7.6.5)



Alternating displays
Initialization running
Icon depending on initialization mode selected

Bar graph display indicating the progress of the initialization

After the basic initialization, the reference curve for the valve signature is recorded (**Code 48 - h0** = YES).



Reading in alternating sequence: TEST/D1

Bar graph display indicating the progress of the initialization

Initialization successful, positioner in automatic operating mode

The time required for an initialization process depends on the transit time of the actuator and may take several minutes.

After a successful initialization, the positioner runs in closed-loop operation indicated by ↻.

A malfunctioning leads to the process being canceled. The initialization error appears on the display according to how it has been classified by the condensed state. See section 8.3.

Note: *An error during the recording of the valve signature is indicated by* ***Code 81****. The valve signature does not affect closed-loop operation.*

Valve closed position AIR TO CLOSE

If the slide switch is set to AIR TO CLOSE, the positioner automatically switches to the direction of action increasing/decreasing (↗↘) on successful completion of initialization.
This results in the following assignment between reference variable and valve closed position:

Valve closed position	Direction of action	Reference variable w Valve CLOSED	Valve OPEN
AIR TO OPEN	↗↗	w = 0 %	w = 100 %
AIR TO CLOSE	↗↘	w = 100 %	w = 0 %

The tight-closing function is activated.

NOTICE
Set Code ***15*** *(final position w>) to 99 % for three-way valves.*

Canceling an initialization process

The initialization procedure can be canceled while running by pressing the rotary pushbutton (⊛). **STOP** appears three seconds long and the positioner then changes to the fail-safe position (SAFE).
Exit the fail-safe position again over Code **0** (see section 8.2.2).

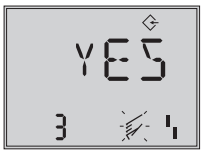
7.6.1 MAX – Initialization based on maximum range

The positioner determines travel/angle of rotation of the closing member from the CLOSED position to the opposite side and

adopts this travel/angle of rotation as the operating range from 0 to 100 %.

Enable configuration:

Note: *If no settings are entered within 120 seconds, the enabled configuration function becomes invalid.*



Default ***No***

Turn ⊛→ **Code 3**, display: ***No***

Press ⊛, Code 3 blinks

Turn ⊛→ ***YES***

Press ⊛, display ⇨

Enter the pin position:

Pin position
Default ***No***

Turn ⊛ → **Code 4**

Press ⊛, Code 4 blinks

Turn ⊛→ Pin position on lever (see relevant section on attachment)

Press ⊛

Turn ⊛→ Skip nominal range (Code 5) and go to Code 6.

Select the initialization mode:

Default ***MAX***

Turn ⊛ → **Code 6**

Press ⊛

Turn ⊛ → ***MAX***

Press ⊛ to confirm ***MAX*** as the initialization mode.

Start initialization:

- Press INIT key to start initialization!

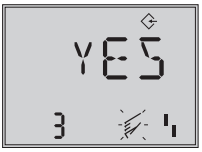
After initialization, the maximum travel/angle of rotation (**Code 5**) which was detected during initialization is indicated.

7.6.2 NOM – Initialization based on nominal range

The calibrated sensor allows the effective valve travel to be set very accurately. During the initialization process, the positioner checks whether the control valve can move through the indicated nominal range (travel or angle) without collision. If this is the case, the indicated nominal range is adopted with the limits of lower travel/angle range value (**Code 8**) and upper travel/angle range value (**Code 9**) as the operating range.

Enable configuration:

Note: *If no settings are entered within 120 seconds, the enabled configuration function becomes invalid.*



Default ***No***

Turn ⊛ → **Code *3***, display: ***No***

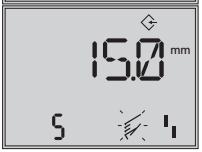
Press ⊛, Code 3 blinks

Turn ⊛ → ***YES***

Press ⊛, display ⇳

Enter pin position and nominal range:

Pin position
Default ***No***



Nominal range
(locked with Code **4** = No)

Turn ⊛ → **Code 4**

Press ⊛, Code 4 blinks

Turn ⊛ → Pin position on lever (read relevant section on attachment)

Press ⊛

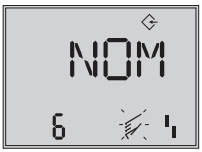
Turn ⊛ → **Code 5**

Press ⊛, Code 5 blinks

Turn ⊛→ Nominal travel/angle

Press ⊛

Select the initialization mode:



Initialization mode
Default ***MAX***

Turn ⊛ → **Code 6**

Press ⊛, Code 6 blinks

Turn ⊛→ ***NOM***

Press ⊛ to confirm the ***NOM*** as the initialization mode.

Start initialization:

- Press INIT key to start initialization!

Note: *If the nominal range determined during initialization is smaller than the range entered in **Code 5**, initialization is canceled and an error message **(Code 52)** is generated.*

After initialization, check the direction of action and, if necessary, change it (Code 7).

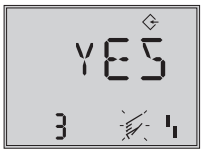
7.6.3 MAN – Initialization based on a manually selected OPEN position

Before starting initialization, move the control valve manually to the OPEN position. The positioner calculates the differential travel/angle from the OPEN and CLOSED

positions and adopts it as the operating range with limits of lower travel/angle range value (**Code 8**) and upper travel/angle range value (**Code 9**).

Enable configuration:

Note: *If no settings are entered within 120 seconds, the enabled configuration function becomes invalid.*



Enable configuration
Default ***No***

Turn ⊛ → **Code *3***, display: ***No***

Press ⊛, Code 3 blinks

Turn ⊛ → ***YES***

Press ⊛, display ⇨

Enter the pin position:

Pin position
Default ***No***

Turn ⊛ → **Code 4**

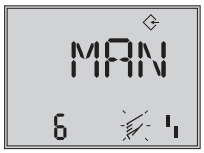
Press ⊛, Code 4 blinks

Turn ⊛ → Pin position on lever (see relevant section on attachment)

Press ⊛

Turn ⊛ → Skip nominal range (Code 5) and go to Code 6.

Select the initialization mode:



Initialization mode
Default ***MAX***

Turn ⊛ → **Code 6**

Press ⊛, Code 6 blinks

Turn ⊛ → ***MAN***

Press ⊛ to confirm the ***MAN*** as the initialization mode.

Enter OPEN position:

Manual set point
(the current angle of rotation is displayed)

Turn ⊛ → **Code 0**

Press ⊛, Code 0 blinks

Turn ⊛ → ***MAN***

Press ⊛

Turn ⊛ → **Code 1**

Press ⊛, Code 1 blinks

Turn ⊛ clockwise in small steps until the required valve position is reached. The valve must be moved with a monotonically increasing signal pressure.

Press ⊛ to confirm the OPEN position.

Start initialization:

- Press INIT key to start initialization!

After initialization, the maximum travel is indicated in mm or the maximum angle in ° in **Code 5**.

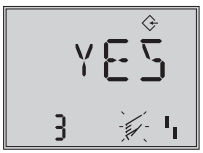
7.6.4 MAN2 – Initialization based on manually selected end positions

Before starting initialization, move the control valve manually to the end positions. The positioner calculates the travel/angle difference from the positions that the valve moved to and adopts it as the operating range with limits of lower travel/angle range value (**Code 8**) and upper travel/angle range value (**Code 9**).

Note: *This initialization mode can only be started when the valve position differs in the end positions and the positioner has not yet been initialized.*

Enable configuration:

Note: *If no settings are entered within 120 seconds, the enabled configuration function becomes invalid.*



Enable configuration
Default ***No***

Turn ⊛ → **Code *3***, display: ***No***

Press ⊛, Code 3 blinks

Turn ⊛ → ***YES***

Press ⊛, display ⇨

Enter the pin position:

Pin position
Default ***No***

Turn ⊛ → **Code 4**

Press ⊛, Code 4 blinks

Turn ⊛→ Pin position on lever (see relevant section on attachment

Press ⊛

Turn ⊛→ Skip nominal range (Code 5) and go to **Code 6**.

Select the initialization mode and enter end positions:

Initialization mode
Default ***MAX***

POS1 (end position 1)

POS2 (end position 2)

Turn ⊛ → **Code 6**

Press ⊛, Code 6 blinks

Turn ⊛ → ***MAN2***

Press ⊛ to adopt the initialization mode ***MAN2*** → ***POS1*** and the current angle position of the lever are indicated on the display in alternating sequence.

Turn ⊛ clockwise in small steps until the required valve position is reached. The valve must be moved with a monotonically increasing signal pressure.

Press ⊛ to confirm the valve position → ***WAIT.*** The valve position is adopted after the pressure settles → ***POS2*** and the current angle position of the lever are indicated on the display in alternating sequence.

Turn ⊛ until the required OPEN position of the valve is reached.

Press ⊛ to confirm the valve position → ***WAIT.*** Initialization can be started as soon as ***MAN2*** is indicated again on the display.

Start initialization:

- Press INIT key to start initialization!

After initialization, the tight-closing function **(Code 14)** is deactivated.

7.6.5 SUB – Substitute calibration

A complete initialization procedure takes several minutes and requires the valve to move through its entire travel range several times. This initialization mode, however, is an emergency mode, in which the control parameters are estimated and not determined by an initialization procedure. As a result, a high level of accuracy cannot be expected. You should always select a different initialization mode if the plant allows it.

The ***SUB*** initialization mode is used to replace a positioner while the process is running. For this purpose, the control valve is usually fixed mechanically in a certain position, or pneumatically by means of a pressure signal which is routed to the actuator externally. The blocking position ensures that the plant continues to operate with this valve position.

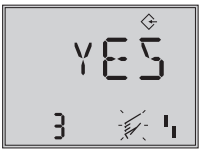
The blocking position can also be the fail-safe position when this condition is beneficial for the temporary phase.

NOTICE

Perform a reset before re-initializing the positioner if the substitute positioner has already been initialized. Refer to section 7.9.

Enable configuration:

Note: *If no settings are entered within 120 seconds, the enabled configuration function becomes invalid.*



Enable configuration
Default ***No***

Turn ⊛ → **Code 3**, display: ***No***

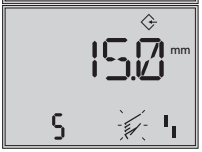
Press ⊛, Code 3 blinks

Turn ⊛ → ***YES***

Press ⊛, display ⇨

Enter the pin position and nominal range:

Pin position
Default ***No***



Nominal range
(locked with Code 4 = No)

Turn ⊛ → **Code 4**

Press ⊛, Code 4 blinks

Turn ⊛ → Pin position on lever (see relevant section on attachment)

Press ⊛

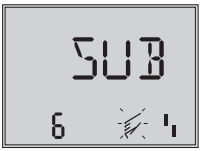
Turn ⊛ → **Code 5**

Press ⊛, Code 5 blinks

Turn ⊛→ Nominal travel/angle

Press ⊛

Select the initialization mode:



Initialization mode
Default ***MAX***

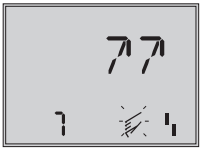
Turn ⊛ → Code **6**

Press ⊛

Turn ⊛ → ***SUB***

Press ⊛ to confirm ***SUB*** as the initialization mode.

Enter the direction of action:



Direction of action
Default ↗↗

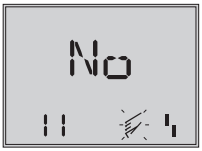
Turn ⊛ → **Code 7**

Press ⊛, Code 7 blinks

Turn ⊛ → Direction of action (↗↗/↗↘)

Press ⊛

Deactivate travel limit:



Travel limit
Default ***100.0***

Turn ⊛ → **Code 11**

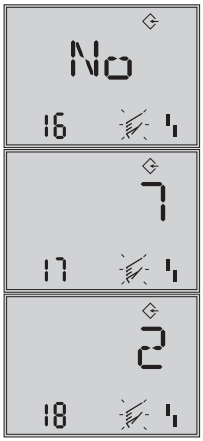
Press ⊛, Code 11 blinks

Turn ⊛ → ***No***

Press ⊛

Change pressure limit and control parameters:

Note: *Do not change the pressure limit (**Code 16**). Only change the control parameters K_P (**Code 17**) and T_V (**Code 18**) if the settings of the replaced positioner are known.*



Pressure limit
Default ***No***

KP level
Default *7*

TV level
Default

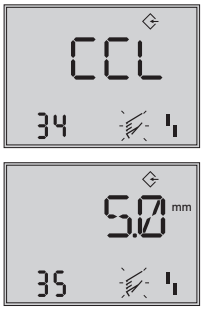
Turn ⊛ → **Code *16/17/18***

Press ⊛, Code 16/17/18 blinks

Turn ⊛ to set the control parameter selected

Press ⊛ to confirm the setting.

Enter closing direction and blocking position:



Closing direction
Direction of rotation causing the valve to move to the CLOSED position (view onto positioner display)
Default: CCL (counterclockwise)

Blocking position
Default: 0

Turn ⊛→ **Code 34**

Press ⊛, Code 34 blinks

Turn ⊛ → Closing direction (CCL counterclockwise/CL clockwise)

Press ⊛

Turn ⊛ → **Code 35**

Press ⊛, Code 35 blinks

Turn ⊛ → Blocking position, e.g. 5 mm (read off at travel indicator scale of the blocked valve or measure with a ruler).

Define the valve closed position:

- Set switch for **valve closed position** AIR TO OPEN or AIR TO CLOSE as described in section 7.1 on page 56.
- Set volume restriction as described in section 7.2 on page 57.

Start initialization:

- Press INIT key!
  The operating mode is changed to automatic mode ⟳.

Note:

– *As initialization has not been carried out completely, the **error code 76** (no emergency mode) and possibly also **error code 57** (control loop) may appear on the display.*
These alarms do not influence the positioner's readiness for operation.

– *If the positioner shows a tendency to oscillate in automatic operating mode, the parameters K_P and T_V must be slightly corrected. Proceed as follows:*
*Set T_V to 4 (**Code 18**).*
*If the positioner still oscillates, the gain K_P (**Code 17**) must be decreased until the positioner shows a stable behavior.*

Zero point calibration

If the process allows it (valve move once to the closed position), perform a zero point calibration according to section 7.7.

7.6.6 Tuning the KP input filter

Changing the KP level (**Code 17**) affects the set point deviation. This effect can be compensated for by tuning the input filter without having to re-initialize the positioner.

Enable configuration:

Turn ⊛ → **Code 3**, display: ***No***

Press ⊛, Code 3 blinks

Turn ⊛ → ***YES***

Press ⊛, display ⇨

Tuning the input filter:

Tuning the input filter
Standard ***MAX***

Turn ⊛ → **Code 6**

Press ⊛, Code 6 blinks

Turn ⊛ → ***KP***

▶ Press INIT key to start initialization!
The tuning is started. During the tuning, the valve moves through its whole range and the input filter is recalibrated.

7.7 Zero calibration

In case of discrepancies with the closing position of the valve, e.g. with soft-sealed plugs, it may become necessary to recalibrate the zero point.

NOTICE
The valve briefly moves from the current travel/angle position to the closed position.

Note:
- *The positioner must be connected to the supply air to perform the zero calibration.*
- *A zero calibration is not possible if there is zero point shift of more than 5 %. In this case, **Code 54** is activated. The positioner must be re-initialized.*

Enable configuration:

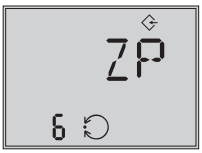
Turn ⊛ → **Code 3**, display: ***No***

Press ⊛, Code 3 blinks

Turn ⊛ → ***YES***

Press ⊛, display ⇨

Perform zero calibration:



Zero calibration
Default ***MAX***

Turn ⊛ → **Code 6**

Press ⊛, Code 6 blinks

Turn ⊛ → ***ZP***

- Press INIT key!
  Zero calibration is started, the positioner moves the control valve to the CLOSED position and readjusts the internal electrical zero point.

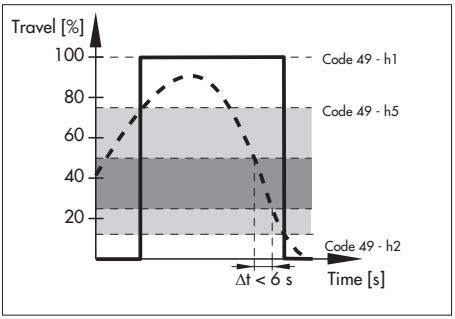
7.8 Settings for on/off valves

If the valve is to be operated using the on/off valve as the type of application, the operating point, test limits and limits for the discrete analysis must be defined.

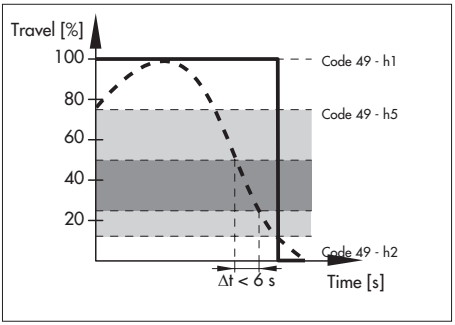
Note: *The travel range of on/off valves is defined using the fail-safe position and the given* Operating point. *As a result, the following parameters to define the operating range and the range of the reference variable (set point) cannot be changed or analyzed:*
*Lower travel/angle range value (**Code 8**)*
*Upper travel/angle range value (**Code 9**)*
*Lower travel/angle limit (**Code 10**)*
*Upper travel/angle limit (**Code 11**)*
*Set point, lower range value (**Code 12**)*
*Set point, upper range value (**Code 13**)*

Discrete analysis

If the reference variable (w ▬ ▬ ▬) is below *Operating point limit* (**Code 49 - h5**) at the start of automatic operation, the valve (▬▬▬) moves to the fail-safe position. If the reference variable increases and exceeds the *Operating point limit,* the valve moves to the *Operating point* (**Code 49 - h1**). The valve moves back to the fail-safe position if the reference variable continues and falls below the *Fail-safe action limit* (**Code 49 - h2**).



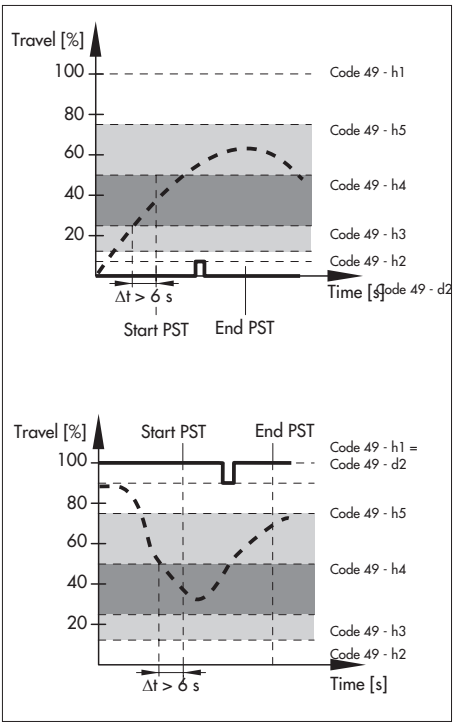
If the reference variable (w ▬ ▬ ▬) is above the *Operating point limit* (**Code 49 - h5**) when automatic mode starts, the valve (▬▬▬) moves to the *Operating point* (**Code 49 - h1**). The valve moves back to the fail-safe position if the reference variable continues and falls below the *Fail-safe action limit* (**Code 49 - h2**).



Triggering the partial stroke test (PST)

A partial stroke test is started when the reference (w ▬ ▬ ▬) moves from the *Operating point* into the range between 25 and 50 % travel and remains there for longer than six seconds. The valve (▬▬▬) moves from the last defined position to the *Lower range value (of step)* (**Code 49 - d2**).

After the partial stroke test is completed, the valve moves back to its previous position (fail-safe position or *Operating point*).



Canceling the partial stroke test (PST)

The partial stroke test is canceled whenever the reference variable changes and falls below the *Fail-safe action limit*. The valve moves back to fail-safe position.

Enable configuration:

Turn ⊛ → **Code 3**, display: ***No***

Press ⊛, Code 3 blinks

Turn ⊛ → ***YES***

Press ⊛, display ⇨

Select on/off valve as type of application:

Turn ⊛ → **Code 49**

Press ⊛, Code 49 blinks

Turn ⊛ → **Code h0**

Press ⊛, Code h0 blinks

Turn ⊛ → ***YES***

Press ⊛

Enter operating point, test limits and limits for discrete analysis:

Turn ⊛ → **Code h1/h2/h3/h4/h5**

Press ⊛, Code h1/h2/h3/h4/h5 blinks

Turn ⊛ to adjust the parameter selected

Press ⊛ to confirm the setting.

7.9 Reset to default values

A reset allows the positioner to be reset to the default settings. To reset the positioner, the options Diag, Std and DS are available in **Code 36**. Table 8 lists the reset functions.

***Note: Code 36 – DS** is usually selected when the valve is mounted in another position or when the positioner is to be mounted to another valve.*
Performing a reset does not necessarily mean the positioner must be re-initialized.

Enable configuration:

Turn ⊛ → **Code 3**, display: ***No***

Press ⊛, Code 3 blinks

Turn ⊛ → ***YES***

Press ⊛, display ⇨

Reset start-up parameters:

Reset
Default ***No***

Turn ⊛ → **Code 36**, display: **– – –**

Press ⊛, Code 36 blinks

Turn ⊛ → ***DIAG/STD/DS***

Press ⊛. The parameters are reset depending on the option selected. Refer to Table 9.

Table 9 · Reset functions		Reset Code 36		
		Diag	Std	DS
Initialization		NO	YES	YES
Fail-safe behavior				
	Air supply failure	NO	NO	YES
	Power supply failure of positioner	NO	NO	YES
	Power supply failure of external solenoid valve	NO	NO	YES
Emergency mode		NO	NO	NO
Operating hours counter		NO	NO	NO
	Device in operation	NO	YES	YES
	Device switched on since initialization	NO	YES	YES
	Device in operation since initialization	NO	YES	YES
Logging		NO	YES	YES
Code no.	**Parameter**			
2	Reading direction	NO	YES	YES
4	Pin position	NO	YES	YES
5	Nominal range	NO	YES	YES
6	Initialization mode	NO	YES	YES
7	Direction of action	NO	YES	YES
8	Lower travel/angle range value	NO	YES	YES
9	Upper travel/angle range value	NO	YES	YES
10	Lower travel/angle range limit	NO	YES	YES
11	Upper travel/angle range limit	NO	YES	YES
12	Set point, lower range value	NO	YES	YES
13	Set point, upper range value	NO	YES	YES
14	CLOSED end position	NO	YES	YES
15	OPEN end position	NO	YES	YES
16	Pressure limit	NO	YES	YES
17	Proportional-action coefficient Kp level	NO	NO	NO
18	Derivative-action time Tv level	NO	NO	NO
19	Tolerance band	NO	YES	YES
20	Select characteristic	NO	YES	YES
21	Enter transit time OPEN	NO	YES	YES
22	Enter transit time CLOSED	NO	YES	YES
24	Total valve travel limit	NO	YES	YES
25	Alarm mode	NO	YES	YES

Table 9 · Reset functions		Reset Code 36		
		Diag	Std	DS
26	Limit A1	NO	YES	YES
27	Limit A2	NO	YES	YES
32	Error message in case of 'Function check' condensed state	NO	YES	YES
33	Error message in case of 'Maintenance required' and 'Out of specification' condensed state	NO	YES	YES
38	Inductive limit switch	NO	NO	NO
46	Bus address	NO	NO	YES
48 -	Diagnosis			
d5	Zero point limit			
d11	Principle of operation (actuator)	NO	NO	YES
h0	Initialization including valve signature	NO	YES	YES
h3	Desired time until 'Reset diagnostic measured data'	NO	NO	YES
49 -	Partial stroke test (PST)			
A2	Test start	NO	NO	NO
A3	Enter test interval	NO	YES	YES
A8	Activate Δp out monitoring	NO	YES	YES
A9	Δp out monitoring value	NO	YES	YES
d2	Lower range value	NO	YES	YES
d3	Upper range value	NO	YES	YES
d4	Activate ramp function	NO	YES	YES
d5	Ramp time (increasing)	NO	YES	YES
d6	Ramp time (decreasing)	NO	YES	YES
d7	Settling time before starting test	NO	YES	YES
d8	Waiting time after step change	NO	YES	YES
d9	Sampling time	YES	YES	YES
E0	Activate x monitoring	NO	YES	YES
E1	x monitoring value	NO	YES	YES
E5	Activate PST tolerance band monitoring	NO	YES	YES
E6	PST tolerance band	NO	YES	YES
E7	Max. test duration	YES	YES	YES
h0	Type of application	NO	YES	YES
h1	Operating point	NO	YES	YES
h2	Fail-safe action limit	NO	YES	YES
h5	Operating point limit	NO	YES	YES

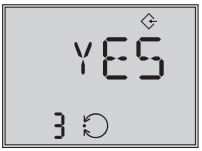
8 Operation

WARNING!
The actuator stem moves while the positioner is being operated.
Do not touch the actuator stem or obstruct it to avoid risk of injury to hands or fingers.

8.1 Enabling and selecting parameters

The code list in section 14 on page 83 onwards contains all codes with their meaning and default settings.
The codes which are marked with an asterisk (*) must be enabled with **Code 3** before the associated parameters can be configured as described below.

Code 3
Configuration not enabled



Configuration enabled

Turn ⊛ → **Code 3**, display: ***No***

Press ⊛, Code 3 blinks.
Change the setting of **Code 3**.

Turn ⊛ → ***YES***

Press ⊛, display: ⇨
Configuration is enabled.

You can now configure codes one after the other:

Turn ⊛ and select the required code.

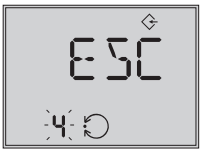
Press ⊛ to access the selected code. The code number starts to blink.

Turn ⊛ and select the setting.

Press ⊛ to confirm the selected setting.

Note: *If no settings are entered within 120 seconds, the enabled configuration function becomes invalid and the display changes to* ***Code 0****.*

Canceling a value before it is confirmed



Canceling the reading

To cancel a value before it is confirmed (by pressing ⊛) proceed as follows:

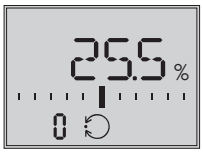
Turn ⊛ → ***ESC***

Press ⊛. The entered value is not adopted.

8.2 Operating modes

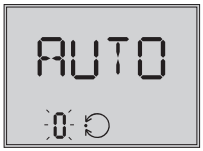
8.2.1 Automatic and manual modes

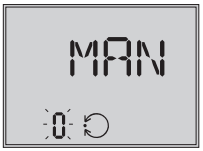
After initialization has been completed successfully, the positioner is in the automatic mode ↻ (AUTO).



Automatic mode

Switch to manual operating mode ✋





Turn ⊛ → Code ***0***

Press ⊛, display: ***AUTO***, Code **0** blinks

Turn ⊛ → ***MAN***

Press ⊛ to change to the manual operating mode ✋.
The switchover is smooth since the manual mode starts up with the set point last used during automatic mode. The current position is displayed in %.

Adjust the manual set point

Turn ⊛→ Code ***1***

Press ⊛, Code **1** blinks

Turn ⊛ until sufficient pressure has been built up in the positioner and the control valve moves to the required position.

Note: *The positioner automatically returns to* ***Code 0*** *if no settings are made within 120 seconds. The positioner remains in the manual mode.*

Switch to automatic operating mode ↻ (AUTO)

Turn ⊛ → Code **0**

Press ⊛, Code **0** blinks

Turn ⊛ → ***AUTO***

Press ⊛. The positioner changes to automatic operating mode.

8.2.2 Fail-safe position (SAFE)

If you want to move the valve to fail-safe position determined during start-up (see section 7.1), proceed as follows:

Turn ⊛ → Code **0**

Press ⊛, display: current operating mode (***AUTO*** or ***MAN***), Code **0** blinks

Turn ⊛ → ***SAFE***

Press ⊛, display: ***S***
The valve moves to the fail-safe position.

Once the positioner is initialized, the current valve position is indicated on the display in %.

Exit the fail-safe position

Turn ⊛ → Code **0**

Press ⊛, Code **0** blinks

Turn ⊛ and select the required operating mode ***AUTO*** or ***MAN***.

Press ⊛.
The positioner switches to the operating mode selected.

8.3 Malfunction/Failure

All status and error messages are classified according to a status in the positioner. The default settings of the status classification are listed in the code list.

Note: *The status classification can only be changed in the operator software, e.g. TROVIS-VIEW 4. For more details, refer to the Operating Instructions EB 8389-1 EN on EXPERTplus Valve Diagnostics.*

To provide a better overview, the classified messages are summarized in a condensed state. The following status messages are available:

- **Failure**
  The positioner cannot perform its control task due to a functional fault in the device or in one of its peripherals or an initialization has not yet been successfully completed.
- **Maintenance required**
  The positioner still performs its control task (with restrictions). A maintenance requirement or above average wear has been determined. The wear tolerance will soon be exhausted or is reducing at a faster rate than expected. Maintenance is necessary in the medium term.
- **Maintenance demanded**
  The positioner still performs its control task (with restrictions). A maintenance demand or above average wear has been determined. The wear tolerance will soon be exhausted or is reducing at a faster rate than expected. Maintenance is necessary in the short term.

- **Out of specification**
  The positioner is operated outside the specified operating conditions.

Note: *If an event is assigned to the 'No message' status, this event does not have any effect on the condensed state.*

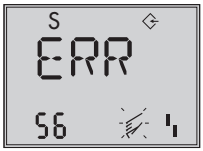
Condensed state

The condensed state appears on the display with the following icons:

Condensed state	Positioner display	Priority
Function check	Text, e.g. ***TUNE*** or ***TEST***	↑
Failure		
Out of specification	blinking	
Maintenance required/ Maintenance demanded		

The message with the highest priority determines the condensed state in the positioner.

If error messages exist, the possible source of error is displayed in **Code 49** onwards. In this case, ***ERR*** appears on the display.



Example:
Error caused by pin position

The cause and recommended action are listed in the code list (section 14).

Fault alarm output

The 'Failure' as the condensed state causes the optional fault alarm output to be switched.

- The 'Function check' condensed state can also activate the fault alarm contact in **Code 32**.
- The 'Maintenance required/ Maintenance demanded' condensed state and 'Out of specification' can also activate the fault alarm contact in **Code 33**.

8.3.1 Confirming error messages

Enable configuration:

Note: *If no settings are entered within 120 seconds, the enabled configuration function becomes invalid.*

Turn ⊛ → Code **3**, display: ***No***

Press ⊛, Code **3** blinks

Turn ⊛ → ***YES***

Press ⊛, display: ⇨

Confirm error messages:

Turn ⊛ → Error code which you want to confirm.

Press ⊛ to confirm the error message.

9 Adjusting the limit switch

The positioner version with inductive limit switch has one adjustable tag (1) mounted on the shaft which operates the proximity switch (3).

For operation of the inductive limit switch, the corresponding switching amplifier according to EN 60947-5-6 (see section 5.2.1) must be connected to the output.

If the tag (1) is inside the field of the switch, the switch assumes a high resistance. If the tag is outside of the field, the switch assumes a low resistance.

Normally, the limit switch is adjusted such that it will provide a signal in both end positions of the valve. The switch, however, can also be adjusted to indicate intermediate valve positions.

Note: *The inductive limit switch replaces the software limit switch A1 with terminal assignment +41/–42.*
Each switching position can optionally be set to indicate when the tag has entered the field, or when it has left the field.
The second software limit switch remains effective, the function of the software limit switch A1 is disabled.

Software adaptation

Code 38 (inductive alarm is set to ***YES***).
The inductive limit switch is connected to the terminals +41/–42.
The device is set up accordingly in the delivered state.

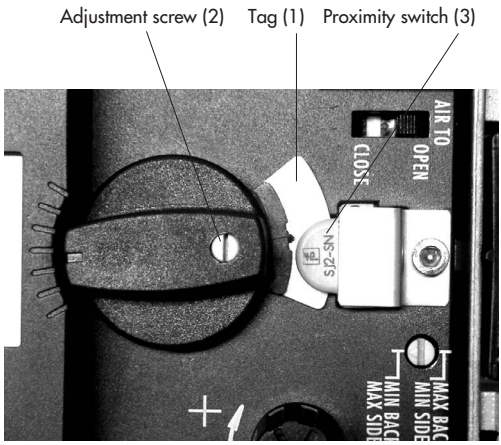


Fig. 23 · Adjustment of the limit switch

Setting the switching point:

NOTICE
During adjustment or testing, the switching point must always be approached from mid-position (50 %).

To ensure safe switching under any ambient conditions, the switching point should be adjusted to a value of approx. 5 % before the mechanical stop (OPEN – CLOSED).

For CLOSED position:

1. Initialize positioner.
2. Use the ***MAN*** function to move the positioner to 5 % (see LC display).
3. Adjust the tag using the yellow adjustment screw (2) until the tag enters or leaves the field and the switching amplifier responds. You can measure the switching voltage as an indicator.

Contact function:

- Tag leaving the field > contact is made
- Tag entering the field > contact is opened.

For OPEN position:

1. Initialize positioner.
2. Use the ***MAN*** function to move the positioner to 95 % (see LC display).
3. Adjust the tag (1) using the yellow adjustment screw (2) until the tag enters or leaves the field of the proximity switch (3).
   You can measure the switching voltage as an indicator.

Contact function:

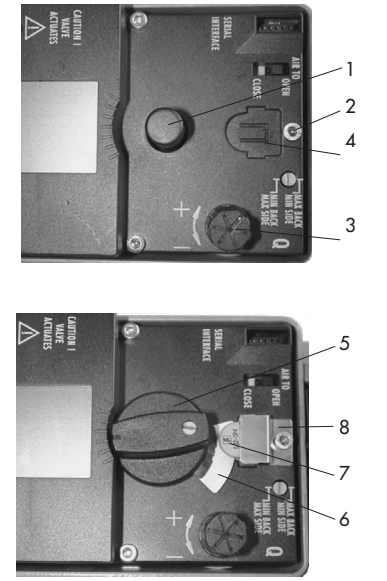
- Tag leaving the field > Contact is made.
- Tag entering the field > Contact is opened.

9.1 Retrofitting an inductive limit switch

Required retrofit kit:
Limit switch Order no. 1400-7460

Note: *For explosion-protected devices, the requirements in section 11 need to be kept.*

1. Take off the rotary pushbutton (3) and cap (1), unthread the five fixing screws (2) and lift off the plastic cover (9).
2. Use a knife to cut an opening at the marked location (4).
3. Push the connector (11) with cable through the opening and secure the proximity switch (7) on the cover with a dot of glue.
4. Remove the jumper (item no. 8801-2267) at the socket X7 of the top board and insert the cable connector (11).
5. Guide the cable in such a manner that the plastic cover can be placed back onto the positioner. Insert the fixing screws (2) and screw tight. Attach the clamping plate (8) onto the proximity switch.
6. Attach the rotary switch (5). Make sure the flattened side of the positioner shaft is turned so that the rotary switch (5) can be attached with the metal tag next to the proximity switch.
7. **Note:** On start-up of the positioner, set the option 'inductive alarm' under **Code 38** from ***No*** to ***YES***.



1	Cap	6	Metal tag
2	Screws	7	Proximity switch
3	Rotary pushbutton	8	Clamping plate
4	Marking	9	Plastic cover
5	Rotary switch	11	Connector

Fig. 24 · Retrofitting an inductive limit switch

10 Maintenance

The positioner does not require any maintenance.

There are filters with a 100 µm mesh size in the pneumatic connections for supply and output which can be removed and cleaned, if required.

The maintenance instructions of any upstream supply air pressure reducing stations must be observed.

11 Servicing explosion-protected devices

If a part of the device on which the explosion protection is based needs to be serviced, the device must not be put back into operation until a qualified inspector has assessed it according to explosion protection requirements, has issued an inspection certificate or given the device a mark of conformity.

Inspection by a qualified inspector is not required if the manufacturer performs a routine test on the device prior to putting it back into operation. The passing of the routine test must be documented by attaching a mark of conformity to the device. Replace explosion-protected components only by original, routine-tested components from the manufacturer.

Devices that have already been in operation outside hazardous areas and are intended for future use inside hazardous areas must comply with the safety requirements placed on serviced devices. Before being used inside hazardous areas, test the devices according to the specifications for servicing explosion-protected devices.

Refer to section 13 for maintenance, calibration and settings within and outside potentially explosive areas.

12 Firmware update (serial interface)

Firmware updates on positioners currently in operation can be performed as follows:

When updates are performed by a service employee appointed by SAMSON, the update is confirmed on the positioner by the test mark assigned by SAMSON's Quality Assurance.

In all other cases, only persons from the plant operator with written approval may perform updates. This person must confirm the update on the positioner.

Laptops and PCs connected to the power supply must use an additional safety barrier.

This does not apply to laptops in battery operation. In this case, it is assumed that a battery-powered laptop runs briefly for software programming or for testing purposes.

a) **Updates outside hazardous area:**

   Remove the positioners from the plant and update them outside the hazardous area.

b.) Updates on site:

Updates on site are only permitted after the plant operator has presented a signed hot work permit.

After updating has been completed, add the current firmware to the nameplate; this can be done using labels.

13 Maintenance, calibration and work on equipment

The interconnection with intrinsically safe circuits to check or calibrate the apparatus must only be performed with intrinsically safe current/voltage calibrators and measuring instruments to rule out any damage to components relevant for explosion protection.

The maximum values for intrinsically safe circuits specified in the approvals must be kept.

14 Code list

Code no.	**Parameter** – Readings, values [default setting]	Description
Note: Codes with marked with an asterisk (*) must be enabled with **Code 3** prior to configuration.		
0	**Operating mode** [MAN] Manual mode AUtO Automatic mode SAFE Fail-safe position ESC Escape	Switchover from automatic to manual mode is smooth. Automatic mode is only possible after the positioner has been initialized. **Refer to section 6 for reading under Code 0**
1	**Manual set point** (manual w) 0 to 100 [0] % of the nominal range *An on/off valve can be moved past 100 % of the nominal range (with the closed position for ATO) or below 0 % of the nominal range (with the closed position for ATC).*	Adjust the manual set point with the rotary pushbutton, the current travel/angle is displayed in % when the positioner is initialized, otherwise the position of the lever in relation to the central axis is indicated in degrees °. ***Note:*** *Can only be selected when* ***Code 0*** *= MAN*
2	**Reading direction** Normal or upside down ESC	The reading direction of the positioner display, depending on the location of the pneumatic connection
3	**Enable configuration** [No] · YES · ESC	Enables the option to modify data (automatically deactivated when the rotary pushbutton has not been operated for 120 s.) Codes marked with an asterisk (*) can only be read and not overwritten. ***HART*** blinks on the display when the on-site operation is locked over HART® communication. ***PST*** appears on the display when the on-site operation is locked by the time-controlled partial stroke test. In these cases, codes can only read over the SSP interface.

<table>
<tr><th>Code no.</th><th>Parameter – Readings, values [default setting]</th><th>Description</th></tr>
<tr><td colspan="3">Note: Codes with marked with an asterisk (*) must be enabled with Code 3 prior to configuration.</td></tr>
<tr><td>4*</td><td>Pin position
[No] · 17, 25, 35, 50, 70, 100, 200 mm · 90° with rotary actuators · 300 mm with piston actuators · ESC
NOTICE If you select a pin position in Code 4 that is too small, the positioner switches to SAFE mode for reasons of safety</td><td>The follower pin must be inserted into the correct pin position according to the valve travel/angle of rotation.
For initialization using NOM (nominal range) or SUB (substitute calibration), the pin position must be entered.
For initialization using MAX, MAN and MAN2, the pin position is not required, however, it is required under Code 5 to display the nominal range.
<table>
<tr><th>Pin position
Code 4</th><th>Default
Code 5</th><th>Adjustment range
Code 5</th></tr>
<tr><td>17</td><td>7.5</td><td>3.6 to 17.7</td></tr>
<tr><td>25</td><td>7.5</td><td>5.0 to 25.0</td></tr>
<tr><td>35</td><td>15.0</td><td>7.0 to 35.4</td></tr>
<tr><td>50</td><td>30.0</td><td>10.0 to 50.0</td></tr>
<tr><td>70</td><td>40.0</td><td>14.0 to 70.7</td></tr>
<tr><td>100</td><td>60.0</td><td>20.0 to 100.0</td></tr>
<tr><td>200</td><td>120.0</td><td>40.0 to 200.0</td></tr>
<tr><td>90°</td><td>90.0</td><td>24.0 to 100.0</td></tr>
<tr><td>300</td><td>200.0</td><td>60.0 to 300.0</td></tr>
</table></td></tr>
<tr><td>5*</td><td>Nominal range
[15.0] mm or angle °
ESC</td><td>For initialization using NOM (nominal range) or SUB (substitute calibration), the nominal range must be entered. The possible adjustment range depends on the pin position from the table for Code 4.
After initialization to the maximum range (MAX), the maximum nominal travel/angle reached on initialization is displayed.</td></tr>
<tr><td>6*</td><td>Initialization mode (init mode)
[MAX] · NOM · MAN
MAN2 · SUB
KP · ZP
ESC</td><td>MAX: Maximum range · For simple start-up of valves with two clearly defined mechanical end positions · The positioner determines travel/angle of rotation of the closing member from the CLOSED position to the opposite stop in the actuator
NOM: Nominal range · For all globe valves · The positioner determines travel/angle of rotation of the closing member from the CLOSED position to the specified nominal range
MAN: Manual setting 1 · For all globe valves with unknown nominal range (OPEN position) · The positioner determines travel/angle of rotation from the manually selected OPEN position (100 %) to the CLOSED position</td></tr>
</table>

Code no.	**Parameter** – Readings, values [default setting]	Description
Note: Codes with marked with an asterisk (*) must be enabled with **Code 3** prior to configuration.		
6*	**Initialization mode** (init mode) - continued -	MAN2: Manual setting 2 · For all globe valves with unknown nominal range (OPEN and CLOSED position) · The positioner determines travel/angle of rotation between the manually selected OPEN (100 %) and the manually selected CLOSED position (0 %) SUB: Substitute calibration · To replace a positioner while the plant is running, with the least amount of disruption to the plant KP: Fine tuning of the input filter · The valve moves through its entire valve range. NP: Zero calibration · The zero point is recalibrated. **NOTICE** The valve moves briefly from the operating point to the closed position!
7*	**Direction of action** (w/x) [↗↗] · ↗↘ · ESC	Direction of action of the set point in relation to the valve position ↗↗: Increasing/increasing: a globe valve opens as the set point increases. ↗↘: Increasing/decreasing: a globe valve closes as the set point increases. The direction of action is adapted to the change in closed direction as follows: ATO: AIR TO OPEN · After initialization, the direction of action remains increasing/increasing (↗↗), a globe valve opens as the mA signal increases. ATC: AIR TO CLOSE · After initialization, the direction of action changes to increasing/decreasing (↗↘), a globe valve opens as the mA signal increases.
8*	**Lower travel/angle range value** (lower x-range value) [0.0] to 80.0 % of the nominal range · ESC Specified in mm or angle°, provided **Code 4** is activated.	Lower range value for the travel/angle of rotation in the operating range. Nominal range and characteristic are automatically adapted. The operating range is the actual travel/angle of the valve and is limited by the lower travel/angle range value (**Code 8**) and the upper travel/angle range value (**Code 9**). Usually, the operating range and the nominal range are identical. The nominal range can be limited to the operating range by the lower and upper x-range values. Value is displayed or must be entered. See also the example in **Code 9**!

Code no.	**Parameter** – Readings, values [default setting]	Description
Note: Codes with marked with an asterisk (*) must be enabled with **Code 3** prior to configuration.		
9*	**Upper travel/angle range value** (upper x-range value) 20.0 to [100.0] % of the nominal range · ESC Specified in mm or angle°, provided **Code 4** is activated.	Upper range value for the travel/angle of rotation in the operating range. Nominal range and characteristic are automatically adapted. **Example:** The operating range is modified, for example, to limit the range of a valve which has been sized too large. For this function, the entire resolution range of the set point is converted to the new limits. 0 % on the display corresponds to the adjusted lower limit and 100 % to the adjusted upper limit.
10*	**Lower travel/angle limit** (lower x-limit) [No] · 0.0 to 49.9 % of the operating range · ESC	Lower limitation of the travel/angle of rotation to the entered value. The characteristic is not adapted.
11*	**Upper travel/angle limit** (upper x-limit) No · 50.0 to120.0 % of the operating range · ESC, [100.0]	Upper limitation of the travel/angle of rotation to the entered value. The characteristic is not adapted. **Example:** In some applications, it is better to limit the valve travel, e.g. if a certain minimum medium flow is required or a maximum flow must not be reached. The lower limit must be adjusted with **Code 10** and the upper limit with **Code 11**. If a tight-closing function has been set up, it has priority over the travel limitation! When set to 'No', the valve can be opened past the nominal travel with a set point outside of the 4 to 20 mA range.

Code no.	**Parameter** – Readings, values [default setting]	Description
Note: Codes with marked with an asterisk (*) must be enabled with **Code 3** prior to configuration.		
12*	**Set point, lower range value** (w-start) [0.0] to 75.0 % · ESC	Lower range value (0 % = 4 mA) of the valid set point range This value must be smaller than the upper range value (w-end). The set point range is the difference between *Set point, upper range value – Set point, lower range value*. The difference must be larger or equal to 25 % (= 4 mA). When the set point range of 0 to 100 % = 4 to 20 mA, the valve moves through its entire operating range from 0 to 100 % travel/angle of rotation. In **split-range operation**, the valves operate with smaller set points. The control signal of the control unit to control two valves is divided such, for instance, that the valves move through their full travel/angle of rotation at only half the input signal (first valve set to 0 to 50 % = 4 to 12 mA and second valve set to 50 to 100 % =12 to 20 mA).
13*	**Set point, upper range value** (w-end) 25.0 to [100.0] % · ESC	Upper range value (100 % = 20 mA) of the valid set point range This value must be greater than the lower range value (w-start).
14*	**CLOSED end position** (end position w <) No · 0.0 to 49.9 % of the span set over Code 12/13 ESC, [1.0]	Limit of the set point w When the set point falls below the limit, an actuator with ATO is completely vented and an actuator with ATC is filled with air. This action always lead to the tight-closing of the valve. Codes **14/15** have priority over Codes **8/9/10/11**. Codes **21/22** have priority over Codes **14/15**.
15*	**OPEN end position** (end position w >) [No] · 50.0 to 100.0 % of the span set over Code 12/13 · ESC ***NOTICE*** *For double-acting actuators (ATO) the pressure limit must not be active!*	Limit of the set point w When the set point falls below the limit, an actuator with ATO is filled with air and an actuator with ATC is completely vented. This action always lead to the maximum opening of the valve. Codes **14/15** have priority over Codes **8/9/10/11**. Codes **21/22** have priority over Codes **14/15**. **Example:** Set the end position w > to 99 % for three-way valves.
16*	**Pressure limit** [No] · 1.4 to 7.0 bar · ESC	The signal pressure to the actuator can be limited. After changing the pressure limit setting, the actuator must be vented once (e.g. by selecting the fail-safe position).

Code no.	**Parameter** – Readings, values [default setting]	Description
Note: Codes with marked with an asterisk (*) must be enabled with **Code 3** prior to configuration.		
17*	**Proportional-action coefficient Kp level** 0 to 17 · ESC, [7] ***NOTICE*** *Changing the K_P level influences the system deviation. This influence can be balanced out by tuning the input filter in* ***Code 6.*** *See section 7.6.6.*	During the initialization of the positioner, the K_P and T_V values are optimized. If the value for the K_P level is below 3, the **error code 61** is activated. Should the positioner show a tendency for impermissibly high post-pulse oscillation due to additional interference, the K_P and T_V levels can be adapted after the initialization. For this, either the T_V level can be increased in increments until the desired response behavior is reached or, when the maximum value of 4 is reached, the K_P level can be decreased in increments.
18*	**Derivative-action time Tv level** No · 1 to 4 · ESC, [2]	See Code 19. A change of the T_V level has no effect on the set point deviation.
19*	**Tolerance band** 0.1 to 10.0 % of the operating range · ESC, [5.0]	Used for error monitoring. If the system deviation is greater than selected tolerance band for a time longer than the lag time [30 s], this causes the **error code 57** (control loop) to be activated. ***Note:*** *The lag time can only be set using the operator software.*
20*	**Select characteristic** [0] to 9 · ESC	Select the characteristic. See section 16 0: Linear 1: Equal percentage 2: Reverse equal percentage 3: SAMSON butterfly valve, linear 4: SAMSON butterfly valve, equal percentage 5: VETEC rotary plug valve, linear 6: VETEC rotary plug valve, equal percentage 7: Segmented ball valve, linear 8: Segmented ball valve, equal percentage 9: User-defined (defined in operator software)

Code no.	**Parameter** – Readings, values [default setting]	Description
Note: Codes with marked with an asterisk (*) must be enabled with **Code 3** prior to configuration.		
21*	**Transit time OPEN** (w ramp OPEN) [0] to 240 s · ESC ***NOTICE*** *The transit time entered in this code does not apply when the safety function is triggered, the solenoid valve/forced venting is activated or when the auxiliary power fails.*	The time required to pass through the operating range when the valve opens. This parameter can be used to increase the *Min. transit time OPEN* (**Code 40**). Limitation of the transit time (**Code 21** and **22**): For some applications it is advisable to limit the transit time of the actuator to prevent it from engaging too fast in the running process. **Code 21** has priority over **Code 15**.
22*	**Transit time CLOSED** (w ramp CLOSED) [0] to 240 s · ESC ***NOTICE*** *The transit time entered in this code does not apply when the safety function is triggered, the solenoid valve/forced venting is activated or when the auxiliary power fails.*	The time required to pass through the operating range when the valve closes. This parameter can be used to increase the *Min. transit time CLOSED* (**Code 41**). **Code 22** has priority over **Code 14**.
23*	**Absolute total valve travel** YES · [0] to 99 · 10^7 · ESC Exponential reading after value reaches 9999	Totaled double valve travel Can be reset to 0 in Code ***36 – STD*** and ***– DS***. ***Note:*** *The value is saved in a non-volatile memory every 24 hours.*
24*	**Total valve travel limit** 1000 to 99 · 10^7 · ESC, [1 000 000] Exponential reading after value reaches 9999	Limit of total valve travel. A 'Total valve travel exceeded' message is issued with the selected status classification when the limit is exceeded. ***Note:*** *The 'Total valve travel exceeded' message has the default status classification 'Maintenance required'. This classification can only be changed in the operator software (e.g. TROVIS-VIEW 4).*

Code no.	**Parameter** – Readings, values [default setting]	Description
Note: Codes with marked with an asterisk (*) must be enabled with **Code 3** prior to configuration.		
25*	**Alarm mode** 0 to 3 · ESC, [2]	Switching mode of software limit switches alarm A1 and A2 in responding state (when positioner has been initialized). **Explosion-protected version according to EN 60947-5-6** 0: A1 ≥ 2.1 mA A2 ≤ 1.2 mA 1: A1 ≤ 1.2 mA A2 ≤ 1.2 mA 2: A1 ≥ 2.1 mA A2 ≥ 2.1 mA 3: A1 ≤ 1.2 mA A2 ≥ 2.1 mA **Version without explosion protection** 0: A1 R = 348 Ω A2 Non-conducting 1: A1 Non-conducting A2 Non-conducting 2: A1 R = 348 Ω A2 R = 348 Ω 3: A1 Non-conducting A2 R = 348 Ω When a positioner has not been initialized, the software limit switches always register the signal as in the state of no response. If there is no mA signal at the terminals 11/12, the software limit switches both switch to ≤ 1.2 mA signal (Ex) or non-conducting (without explosion protection). **Note:** The fault alarm output always switches to ≤ 1.2 mA/ non-conducting in case of a fault. It has ≥ 1.2 mA® = 348 Ω when there is no fault.
26*	**Limit A1** No · 0.0 to 100.0 % of the operating range · ESC, [2.0] ***NOTICE*** *The setting has no effect when an inductive limit switch has been installed.*	Valve position limit in relation to the operating range Alarm A1 responds when the value falls below the limit.
27*	**Limit A2** No · 0.0 to 100.0 % of the operating range · ESC, [98.0]	Valve position limit in relation to the operating range Alarm A2 responds when the value falls below the limit.

Code no.	**Parameter** – Readings, values [default setting]	Description
Note: Codes with marked with an asterisk (*) must be enabled with **Code 3** prior to configuration.		
28*	**Alarm test** Reading direction: Standard / Turned [No] / [No] RUN 1 / 1 RUN RUN 2 / 2 RUN RUN 3 / 3 RUN ESC / ESC	Test Testing the software limit switches alarm A1 and A2 as well as the fault alarm contact A3. On activating the test, the contacts switch five times. RUN1/1 RUN: Software limit switch A1 to ≥ 2.1mA RUN2/2 RUN: Software limit switch A2 to ≥ 2.1 mA RUN3/3 RUN: Fault alarm contact A3 to ≤ 1.2 mA
29*	**Position transmitter x/ix** [3] [↗↗] · ↗↘ · ESC	Operating direction of the position transmitter. This indicates how the travel/angle position is assigned to the output signal I, based on the closed position. The operating range (see **Code 8**) of the valve is represented by the 4 to 20 mA signal. Values exceeding or falling below the limits 2.4 to 21.6 mA can be represented. When a positioner has not been connected (set point less than 3.6 mA), the signal is 0.9 mA and 3.8 mA or 4.4 mA when the positioner has not been initialized. When **Code 32** = *YES*, the position transmitter issues the value as set in **Code 30** during initialization or zero calibration. When **Code 32** = *No*, 4 mA is issued during a running self-adaptation.
30*	**Fault alarm ix** [3] [No] · HI · LO · ESC	Used to select whether faults causing the fault alarm contact to switch should also be indicated by the position transmitter output and how they should be signaled HI ix = 21.6 ±0.1mA or LO ix = 2.4 ±0.1mA
31*	**Position transmitter test** [3] –10.0 to 110.0 % of the operating range · ESC, [default value is last indicated value of the position transmitter]	Testing the position transmitter. Values can be entered in relation to the operating range. The momentary valve position is used in initialized positioners locally as the start value (bumpless changeover to the test mode). On testing over software, the entered simulation value is issued as the position feedback signal for 30 seconds.
[3]Analog position transmitter: **Code 29/30/31** can only be selected if the position transmitter (optional) is installed.		
32*	**Error message in case of 'Function check' condensed state** [YES] · No · ESC	YES: 'Failure' and 'Function check' condensed state cause an error message to be generated. No: Only 'Failure' condensed state causes an error message to be generated.

Code no.	**Parameter** – Readings, values [default setting]	Description
Note: Codes with marked with an asterisk (*) must be enabled with **Code 3** prior to configuration.		
33*	**Error message in case of 'Maintenance required' and 'Out of specification' condensed states** [YES] · No · ESC	YES: 'Failure', 'Maintenance required' and 'Out of specification' condensed state cause an error message to be generated. No: Only 'Failure' condensed state causes an error message to be generated.
34*	**Closing direction** CL · [CCL] · ESC	CL : Clockwise CCL: Counterclockwise Turning direction in which the valve is moved to the CLOSED position (view onto the rotary switch motion when the positioner cover is open). ***Note:*** *Only needs to be entered when the SUB initialization mode (**Code 6**) is selected.*
35*	**Blocking position** [0] mm/° /% · ESC	Distance up to CLOSED position *Note: Only needs to be entered when the SUB initialization mode (**Code 6**) is selected.*
36*	**Reset** STD · DIAG · DS · ESC	STD: Reset start-up – Parameters are reset to their default settings – Diagnosis data are reset – Information parameters (read only) remain unchanged – Positioner must be re-initialized DIAG: Reset diagnosis data – Parameter settings, reference data and logging remain unchanged – Re-initialization not required DS: Reset positioner to default settings – Parameters are reset to their default settings – Diagnosis data are reset – Information parameters (read only) are deleted – Positioner must be re-initialized

Code no.	**Parameter** – Readings, values [default setting]	Description
Note: Codes with marked with an asterisk (*) must be enabled with **Code 3** prior to configuration.		
37	**Options** Read only	Indicates which option (connected to terminals 31 and 32, Fig. 18) is installed: No: No option installed POS: Analog position transmitter dI: Binary input LS: Leakage sensor When the binary input is used, *DI* and *HIGH* or *LOW* status are displayed in alternating sequence. When the leakage sensor is used, *LS* and the detected sound level in dB are displayed in alternating sequence.
38*	**Inductive limit switch** [No] · YES · ESC	Indicates whether the inductive contact option is installed.
39	**Set point deviation e** Read only	Shows the set point deviation (e = w – x)
40	**Min. transit time OPEN** Read only	Minimum opening time determined during initialization
41	**Min. transit time CLOSED** Read only	Minimum closing time determined during initialization
42	**Set point** Read only	Set point w applied for automatic mode 4 to 20 mA corresponds with 0 to 100 %
43	**Firmware version** Read only	Device type and current firmware version (displayed in alternating sequence)
44	**Info y** Read only	Control signal y in %, in relation to the travel range determined during initialization MAX: The positioner builds up its maximum output pressure. See description for **Code 14, 15**. 0 P: The positioner vents completely. See description for **Code 14, 15**. – – –: The positioner is not initialized.

Code no.	**Parameter** – Readings, values [default setting]	Description
Note: Codes with marked with an asterisk (*) must be enabled with **Code 3** prior to configuration.		
45	**Internal solenoid valve/ forced venting** Read only	Indicates whether a solenoid valve/forced venting is installed. If a voltage supply is connected at the terminals +81/–82, *YES* and *HIGH* appear on the display in alternating sequence. If a voltage supply is not connected (actuator vented, fail-safe position indicated on the display by the **S** icon), *YES* and *LOW* appear on the display in alternating sequence.
46*	**Bus address** [0] to 15 · ESC	Using the HART® protocol, all connected control room devices and field devices can be addressed individually using a point-to-point connection or the standard (multidrop) bus. Point-to-point: HART® master drive connected on HART® field device. With this connection, the positioner address must always be set to '0'. Standard (multidrop) bus: A maximum of 15 field devices can be connected in parallel to a single pair of wires. The HART® master drive tells them apart by their addresses in the range from 1 to 15.
47*	**HART® write protection** [No] · YES · ESC	When the write protection function is activated, device data can only be read, but not overwritten over HART® communication.
48 -	**Diagnosis** ***Note:*** *For more details, refer to the Operating Instructions EB 8389-1 EN on EXPERTplus Valve Diagnostics.*	
d0	**Temperature** Read only	Current operating temperature [°C] inside the positioner (accuracy ±3 %)
d1	**Minimum Temperature** Read only	Lowest temperature [°C] inside the positioner since the operating hours counter started counting
d2	**Maximum temperature** Read only	Highest temperature [°C] inside the positioner since the operating hours counter started counting
d3	**Number of zero calibrations** Read only	The number of zero calibrations performed since the last initialization.
d4	**Number of initializations** Read only	The number of initializations that have been performed since the last start with default settings.

Code no.	**Parameter** – Readings, values [default setting]	Description
Note: Codes with marked with an asterisk (*) must be enabled with **Code 3** prior to configuration.		
d5*	**Zero point limit** 0.0 to 100.0 % of the nominal range · ESC, [5.0]	Valve position limit in relation to the nominal range When the limit is exceeded, a 'Zero point' message (**Code 58**) is generated according to the status classification selected. ***Note:*** *The 'Zero point' message (Code 58) has the default status classification 'Maintenance required'. This classification can only be changed in the operator software (e.g. TROVIS-VIEW 4) .*
d6	**Condensed state** Read only	Summary of all the classified status messages according to the NAMUR Recommendation NE 107 OK: No message C: Maintenance required CR: Maintenance demanded S: Out of specification B: Failure I: Function check
d7	**Supply pressure p_s** Read only	Current supply pressure [bar]
d8	**Signal pressure p_{out}** Read only	Current signal pressure [bar]
d9	**Flow rate** Read only	Current flow rate through the valve ***Note:*** *– – – – appears on the display when the flow rate calculation is not active or has failed.*
d10	**Differential pressure** Read only	Current differential pressure [bar]
d11*	**Direction of action (actuator)** [-/-] · SA · DA · ELSE · ESC	Indicates the actuator's direction of action SA: Single-acting DA: Double-acting ELSE: Other

Code no.	**Parameter** – Readings, values [default setting]	Description
Note: Codes with marked with an asterisk (*) must be enabled with **Code 3** prior to configuration.		
h0*	**Initialization including valve signature** No · [YES] · ESC	Initialization with [YES] or without [No] plotting the valve signature The valve signature involves the signal pressure p_{out} being plotted in relation to the valve position. The valve signature is plotted during initialization of an uninitialized positioner (e.g. after initialization has been reset (**Code 36 - STD** and **Code 36 - DS**)). The valve signature is also plotted during each further initialization when one of the settings in *Initialization mode* (**Code 6**), *Pin position* (**Code 4**), *Direction of action* (**Code 7**), *Pressure limit* (**Code 16**), *Proportional-action coefficient Kp level* (**Code 17**) or *Derivative-action time Tv level* (**Code 18**) is changed as well as when the switch position (ATO/ATC) has been changed. ***Note:*** *The valve signature is required to perform diagnostic functions. For more details, refer to the Operating Instructions EB 8389-1 EN on EXPERTplus Valve Diagnostics.*
h1	– Unassigned –	
h2	– Unassigned –	
h3*	**Desired time until 'Reset diagnostic measured data'** [0] to 365 days · ESC	Time interval between scheduled reset of diagnosis data
h4	**Remaining time until 'Reset diagnostic measured data'** Read only	Remaining time (time and unit of time displayed in alternating sequence) until the next scheduled reset of the diagnosis data
49	**Partial stroke test (PST)** ***Note:*** *The Operating Instructions EB 8389-1 EN on EXPERTplus Valve Diagnostics contain further details on the partial stroke test (PST).*	
A0*	**Start test** [No] · YES · ESC	Start partial stroke test (Test D4). The valve moves through the test range (*Lower range value* (**Code 49 - d2**) to *Upper range value* (**Code 49 - d3**)) and back again in a ramp or in steps. The time, set point, valve position, set point deviation and the control signal are recorded.
A1	**Time until next test** Read only	Remaining time (time and unit of time displayed in alternating sequence) until the next time-controlled test starts

Code no.	**Parameter** – Readings, values [default setting]	Description
Note: Codes with marked with an asterisk (*) must be enabled with **Code 3** prior to configuration.		
A2*	**Test** AUTO · [MAN] · ESC ***NOTICE*** *The write protection is active in the AUTO setting (local operation and operation over software locked)*	Activates (AUTO) or deactivates (MAN) the time-controlled partial stroke test.
A3*	**Test interval**	Test interval (time and unit of time displayed in alternating sequence) until starting the time-controlled test
A4	– Unassigned –	
A5	**Recommended min. sampling time** Read only	Sampling time [s] used to record entire step response in the graph of the partial stroke test.
A6	– Unassigned –	
A7	**Δp_out reference value** Read only	The valve moves to the lower range value (**Code 49 - d2**) and upper range value (**Code 49 - d3**) with a certain signal pressure. The *Δp_out reference value [bar]* is calculated from the two signal pressures. ***Note:*** *The reference value only applies to the adjusted step and ramp values.*
A8*	**Activate Δp_out monitoring** [No] · YES · ESC	Activates (YES) or deactivates (No) the Δp_out monitoring.
A9*	**Δp_out monitoring value** 0.00 to 7.00 bar · ESC, [1.00]	The test is canceled whenever the signal pressure change falls below and exceeds the reference value. The reference value is made up of *Δp out reference value* (**Code 49 - A7**) and the *Δp_out monitoring value*.
d0	– Unassigned –	
d1	– Unassigned –	
d2*	**Lower range value** 0.0 to [100.0] % · ESC	Start value of the test ***Note:*** *To perform the partial stroke test, the* Lower range value *must be within the range of the current operating point* ± Tolerance limit. *The* Tolerance limit *is 2.0 % by default. It can be changed in the operator software, e.g. TROVIS-VIEW 4.*

Code no.	**Parameter** – Readings, values [default setting]	Description
Note: Codes with marked with an asterisk (*) must be enabled with **Code 3** prior to configuration.		
d3*	**Upper range value** 0.0 to 100.0 % · ESC, [90.0]	Final value of the test
d4*	**Activate ramp function** No · [YES]	YES: The valve is ramped through the test range within the adjusted ramp time. No: The valve is moved in steps through the test range (step response).
d5*	**Ramp time (decreasing)** 0 to 9999 s · ESC, [45]	Time period in which the valve moves through the operating range from the closed to the open position The time to move from *Lower range value* (**Code 49 - d2**) to *Upper range value* (**Code 49 - d3**) is calculated: *Upper range value – Lower range value* / 100 x *Ramp time (increasing)*
d6*	**Ramp time (increasing)** 0 to 9999 s · ESC, [45]	Time period in which the valve moves through the operating range from the open to the closed position The time to move from *Upper range value* (**Code 49 - d3**) to *Lower range value* (**Code 49 - d2**) is calculated: *Lower range value – Upper range value* / 100 x *Ramp time (decreasing)*
d7*	**Settling time before starting test** 1 to 240 s · ESC, [10]	Settling time between reaching the upper range value (**Code 49 - d3**) and the valve moving through the test range in the reverse direction
d8*	**Waiting time after step change** 1.0 to 240.0 s · ESC, [2.0]	Waiting time between step change from *Lower range value* (**Code 49 - d2**) to *Upper range value* (**Code 49 - d3**) and vice versa
d9*	**Sampling time** [0.2] to 250.0 s · ESC	Time interval between measuring data
E0*	**Activate x monitoring** No · [YES]	Activates x monitoring (YES) or deactivates it (No)
E1*	**x monitoring value** –10.0 to 110.0 % of the entire travel · ESC, [85.0]	The test is canceled when the valve moves below the adjusted value.
E2	– Unassigned –	
E3	– Unassigned –	

Code no.	**Parameter** – Readings, values [default setting]	Description
Note: Codes with marked with an asterisk (*) must be enabled with **Code 3** prior to configuration.		
E4	– Unassigned –	
E5*	**Activate PST tolerance band monitoring** [No] · YES	Activates PST tolerance band monitoring (YES) or deactivates it (No)
E6*	**PST tolerance band** 0.1 to 100.0 % · ESC, [5.0]	The test is canceled when the deviation in valve position (in relation to the upper range value of the step) exceeds the adjusted value.
E7*	**Max. test duration** 30 to 25000 s · ESC [30]	The test is canceled when the maximum test duration is reached.
E8	– Unassigned –	
E9*	**Reset 'Partial stroke test parameters'**	Resets partial stroke test parameters
F0	**No test available**	
F1	– Unassigned –	
F2	**x cancelation**	The test was canceled. The valve position fell below the *x monitoring value* (**Code 49 - E1**).
F3	**Δp_out cancelation**	The test was canceled. The change in signal pressure (Δp_out) fell below or exceeded the reference value (**Code 49 - A9**).
F4	**Tolerance band exceeded**	The deviation of the valve position exceeded the adjusted *PST tolerance band* (**Code 49 - E6**).
F5	**Max. test duration exceeded**	The test was canceled. The *Max. test duration* (**Code 49 - E7**) was reached.
F6	**Test canceled manually**	
F7	**Measured data memory full**	The *Sampling time* (**Code 49 - d9**) is too low. After recording 100 data points per variable, logging is stopped, but the test continues until it is completed.
F8	**Cancelled by internal solenoid valve/forced venting**	The test was canceled. The internal solenoid valve has been energized/the forced venting has been activated.

Code no.	**Parameter** – Readings, values [default setting]	Description
Note: Codes with marked with an asterisk (*) must be enabled with **Code 3** prior to configuration.		
F9	**Canceled by control loop error**	The test was canceled. A control loop error has occurred.
	Type of application ***Note:*** *Section 7.8 contains details on the on/off valve.*	
h0	**Type of application** [No] · YES · ESC	No: Control valve YES: On/off valve Depending on the selected type of application, the positioner behaves differently in automatic mode and has different diagnostic functions. Refer to section 3.4.
h1	**Operating point** 0.0 to [100.0] % valve position · ESC	Valve position when set point w > *Operating point limit* (**Code 49 - h5**)
h2	**Fail-safe action limit** 0.0 to 20.0 % set point · ESC, [12.5]	Limit of set point w A limit violation causes the valve to move to the fail-safe position.
h3	**Lower limit to start test** [25.0 % set point]	If the set point is between *Lower limit to start test* (25 %) and *Fail-safe action limit* (**Code 49 - h2**), the valve remains in its last valid position. If the set point remains between *Lower limit to start test* (25 %) and *Upper limit to start test* (50 %) for six seconds, a partial stroke starts. After the partial stroke test is completed, the valve moves back to the last valid position.
h4	**Upper limit to start test** [50.0 % set point]	If the set point is between *Operating point limit* and *Upper limit to start test* (50 %), the valve remains in its last valid position. If the set point remains between *Lower limit to start test* (25 %) and *Upper limit to start test* (50 %) for six seconds, a partial stroke starts. After the partial stroke test is completed, the valve moves back to the last valid position.
h5	**Operating point limit** 55.0 to 100.0 % set point · ESC, [75.0]	Limit of set point w A limit violation causes the valve to move to the *Operating point* (**Code 49 - h1**).

Note: *The error codes listed in following appear in the display corresponding to their status classification set over the condensed state (Maintenance required/Maintenance demanded: 🔧, Out of specification: 🔧 blinking, Failure alarm: ▮).*
If 'No message' is assigned to the error code as the status classification, the error is not included in the condensed state.
A status classification is assigned to every error code in the default setting. The status classification of error codes can also be changed as required in an operator software, e.g. TROVIS-VIEW 4.

Initialization errors

Error codes – Recommended action		Condensed state alarm active, when prompted, ***ERR*** appears. When error messages exist, they are displayed here.
50	**x > range**	The value supplied by the measuring signal is either too high or too low, the measuring sensor is close to its mechanical limit. – Pin positioned incorrectly – NAMUR attachment: bracket slipped or follower pin is not in the slot of the follower plate – Follower plate incorrectly attached
	Status classification	[Maintenance required]
	Recommended action	– Check attachment and pin position. – Re-initialize the positioner.
51	**Δx < range**	The measuring span of the sensor is too low. – Pin positioned incorrectly – Incorrect lever installed – Pressure limit selected too low A rotational angle smaller than 16° at the positioner shaft creates just an alarm. An angle below 9° leads to the initialization being canceled.
	Status classification	[Out of specification]
	Recommended action	– Check attachment and pressure limit. – Re-initialize the positioner.
52	**Attachment**	– The nominal range could not be achieved during initialization with NOM initialization mode (the maximum travel/angle reached is indicated on the display). – Incorrect lever installed – Supply pressure too low. The valve cannot move to the required position.
	Status classification	[Maintenance required]
	Recommended action	– Check attachment and supply pressure. – Re-initialize the positioner.

Error codes – Recommended action		Condensed state alarm active, when prompted, ***ERR*** appears. When error messages exist, they are displayed here.
53	**Initialization time exceeded (Init time >)**	The initialization routine lasts too long. – The valve opens after a considerable delay. – The valve does not have fixed end stops (possible with a lined control butterfly). – The valve has a strong tendency to hunt.
	Status classification	[Maintenance required]
	Recommended action	– Check supply pressure. If necessary, install a pneumatic booster. – Adjust end stops. – Reduce tendency to hunt (e.g. restrict or open booster bypass). Then re-initialize the positioner.
54	**Initialization - internal solenoid valve/forced venting**	1) Internal solenoid valve/forced venting not connected or incorrectly connected. 2) If you attempt to initialize the device from the fail-safe position (SAFE).
	Status classification	[Maintenance required]
	Recommended action	Re. 1) – Check connection and supply voltage of the solenoid valve/ forced venting – Re-initialize the positioner. Re. 2) – Switch to ***MAN*** operating mode. – Re-initialize the positioner.
55	**Transit time too short (transit time <)**	The actuator positioning rates determined during the initialization are so short (< 0.3 s) that the positioner cannot adapt itself optimally.
	Status classification	[Out of specification]
	Recommended action	– Activate the volume restriction in the positioner output. – Re-initialize the positioner.
56	**Pin position/switch position**	1) The pin position was not entered for the initialization modes ***NOM*** and ***SUB***. 2) The switch (ATO/ATC) is defective
	Status classification	[Maintenance required]
	Recommended action	Re. 1) – Enter pin position and nominal range. – Re-initialize the positioner. Re. 2) – Return the positioner to SAMSON for repair.

Operational errors

Error codes – Recommended action		Condensed state alarm active, when prompted, ***ERR*** appears. When fault alarms exist, they are displayed here.
57	**Control loop** Additional indication at the fault alarm contact!	Control loop error: the control valve does not react within the tolerable times of the controlled variable (tolerance band alarm **Code 19**). – Actuator is mechanically blocked. – Attachment of the positioner has subsequently shifted. – Supply pressure not sufficient.
	Status classification	[Maintenance required]
	Recommended action	– Check attachment. – Check supply pressure.
58	**Zero point**	– Mounting position or linkage of the positioner has moved. – Valve seat trim is worn, especially with soft-sealed plugs.
	Status classification	[Maintenance required]
	Recommended action	– Check valve and the attachment of the positioner. – Perform a zero calibration. A reinitialization is recommended for deviations of the zero point over 5 %.
59	**Inconsistent data memory**	The error is automatically recognized by the self-monitoring function and corrected.
	Status classification	Failure (status classification change not possible)
60	**Internal device error** Additional indication at the fault alarm contact!	The positioner changes to the fail-safe position (SAFE).
	Status classification	Failure (status classification change not possible)
	Recommended action	Return the positioner to SAMSON AG for repair.
61	**KP too small**	A proportional-action coefficient Kp level smaller than 3 has been detected during initialization. ***Note:*** *A Kp level < 3 does not cause the initialization process to be canceled.*
	Status classification	[Maintenance required]
	Recommended action	– Activate the volume restriction in the outlet of the positioner. – Increase the bypass restriction setting of booster (if installed).

Hardware errors

Error codes – Recommended action		Condensed state alarm active, when prompted, ***ERR*** appears. When fault alarms exist, they are displayed here.
62	**x signal** Additional indication at the fault alarm contact!	– Measured data recording for actuator has failed. – Conductive plastic element is defective. The emergency mode on the display is indicated by a blinking closed-loop operation icon and 4 dashes instead of the position indication. **Open-loop operation:** If the measuring system has failed, the positioner is still in a reliable state. The positioner switches to emergency mode where the position cannot be accurately controlled anymore. However, the positioner continues operation according to its reference variable signal so that the process remains in a safe state.
	Status classification	[Maintenance required]
	Recommended action	– Return the positioner to SAMSON AG for repair.
63	**SIL shutdown/w too small**	1) Emergency shutdown of the i/p block is implemented by 3.8 mA or 4.4 mA (depending on the positioner version) 2) The set point w is smaller than 3.7 mA. This state is indicated on the positioner display by a blinking ***LOW***
	Status classification	[No message]
	Recommended action	Re. 1) Raise the current (depending on version) above the limit. Re. 2) Check set point. If necessary, limit the current source downwards so that no values below 3.7 mA can be issued.
64	**i/p converter**	– The circuit of the i/p converter has been interrupted.
	Status classification	Failure (status classification change not possible)
	Recommended action	– Return the positioner to SAMSON AG for repair.

Error appendix

Error codes – Recommended action		Condensed state alarm active, when prompted, ***ERR*** appears. When fault alarms exist, they are displayed here.
65	**Hardware** Additional indication at the fault alarm contact!	A hardware error has occurred, the positioner changes to the fail-safe position (***SAFE***). As long as the error exists, no EXPERTplus diagnostic messages are logged.
	Status classification	[Failure]
	Recommended action	Confirm error and return to the automatic operating mode, or perform a reset and re-initialize the device. If this is not successful, return device to SAMSON AG for repair.
66	– Unassigned –	
67	**Test calculation** Additional indication at the fault alarm contact!	The hardware controller is monitored by means of a test calculation.
	Status classification	[Failure]
	Recommended action	Confirm error. If this is not possible, return the positioner to SAMSON AG for repair.

Data errors

Error codes – Recommended action		Condensed state alarm active, when prompted, ***ERR*** appears. When fault alarms exist, they are displayed here.
68 to 75	– Unassigned –	
76	**No emergency mode**	The travel measuring system of the positioner has a self-monitoring function (see **Code 62**). An emergency mode (open-loop control) is not available for certain actuators, such as double-acting actuators. In this case, the positioner vents the output when a measuring error occurs or A1 with double-acting actuators. During the initialization, the positioner checks whether the actuator has such a function or not.
	Status classification	[No message]
	Recommended action	Merely information, confirm, if necessary. No further action necessary.

Diagnostic errors

Error codes – Recommended action		Condensed state alarm active, when prompted, ***ERR*** appears. When fault alarms exist, they are displayed here.
77	– Unassigned –	
78	– Unassigned –	
79	**Collective error**	Messages generated by EXPERTplus exist. The error does not have any direct effect on the positioner's functioning. Refer to Operating Instructions EB 8389-1 EN on EXPERTplus Valve Diagnostics
	Status classification	Maintenance required (status classification change not possible)
80	– Unassigned –	
81	**Valve signature canceled**	Error during automatic plotting of the valve signature Error messages are saved in a non-volatile memory. They cannot be reset.
	Status classification	[Maintenance required]
	Recommended action	Restart plotting of the valve signature or start initialization including valve signature.
83	– Unassigned –	
84	**Partial stroke test (PST)/full stroke test (FST)**	A partial stroke test or full stroke test cannot be started or has been canceled. Refer to Operating Instructions EB 8389-1 EN on EXPERTplus Valve Diagnostics.
	Status classification	No message
	Recommended action	Read out test status (only in the operator software)
85	**On/off valve**	The transit time and breakaway time or the final travel/angle value of the on/off valve has changed.
	Status classification	No message
	Recommended action	Check valve and actuator.

Error codes – Recommended action		Condensed state alarm active, when prompted, ***ERR*** appears. When fault alarms exist, they are displayed here.
86	**SIL tests**	The SIL operator test has failed. Refer to Operating Instructions EB 8389-1 EN on EXPERTplus Valve Diagnostics.
	Status classification	Failure (status classification change not possible)
	Recommended action	Return the positioner to SAMSON AG for repair.

15 Dimensions in mm

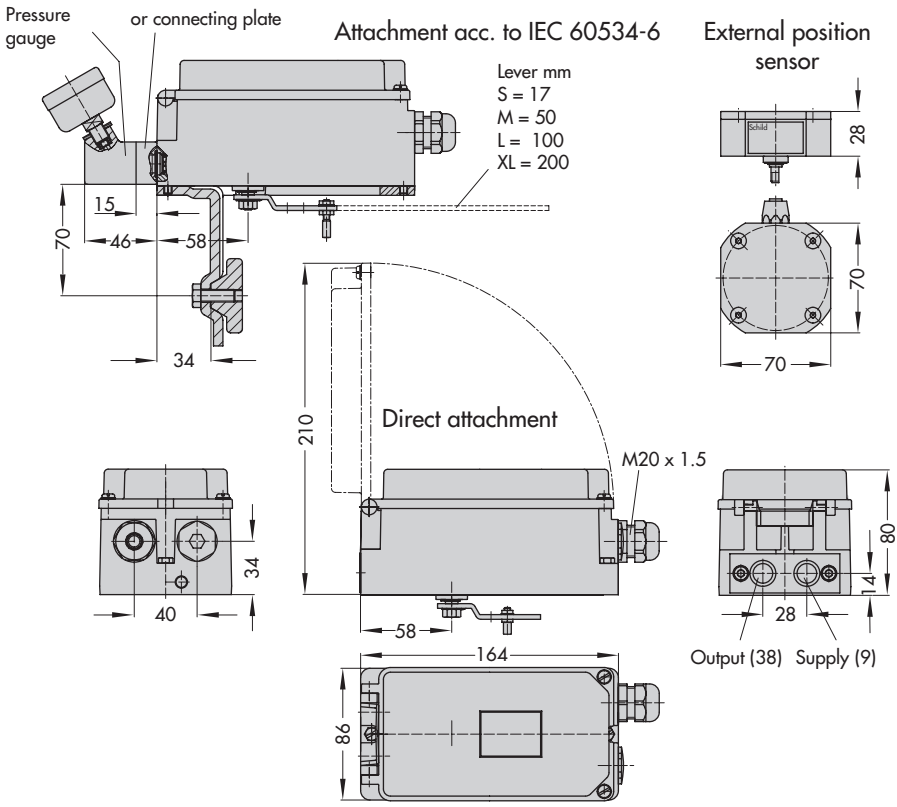


Fig. 23a · NAMUR and direct attachment

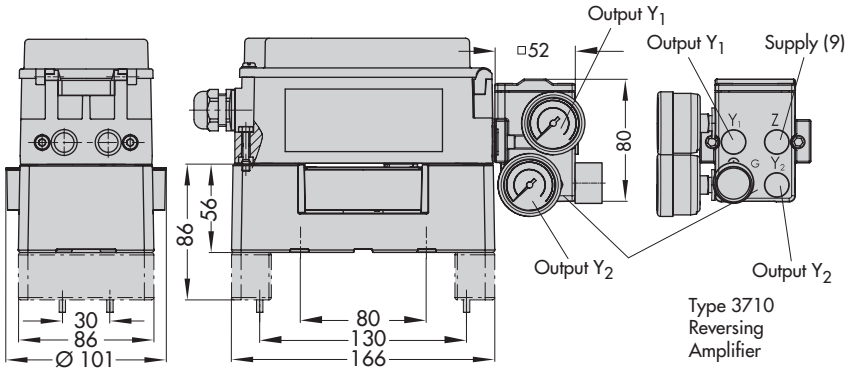
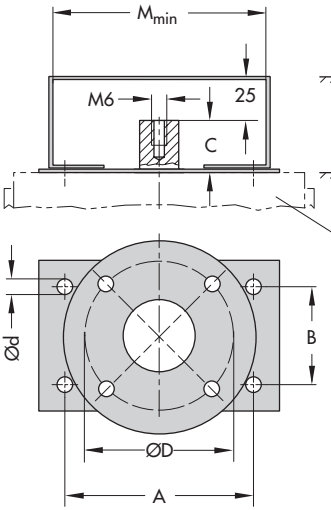


Fig. 23b · Attachment to rotary actuators VDI/VDE 3845 (Sept. 2010), level 1, size AA1 to AA4

15.1 Fixing levels according to VDI/VDE 3845 (September 2010)



Dimensions in mm

Size	A	B	C	Ød	M_{min}	ØD*
AA0	50	25	15	5.5 for M5	66	50
AA1	80	30	20	5.5 for M5	96	50
AA2	80	30	30	5.5 for M5	96	50
AA3	130	30	30	5.5 for M5	146	50
AA4	130	30	50	5.5 for M5	146	50
AA5	200	50	80	6.5 for M6	220	50

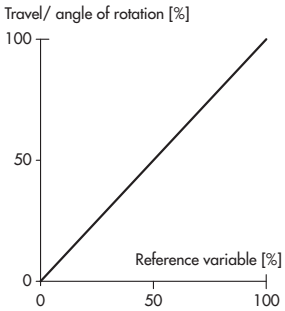
* Flange type F05 according to DIN EN ISO 5211

16 Valve characteristic selection

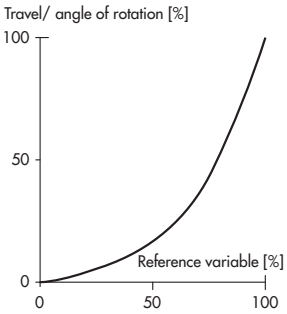
The characteristics that can be selected in **Code 20** are shown in following in graph form.

Note: *A characteristic can only be defined (user-defined characteristic) using the operator software (e.g. TROVIS-VIEW 4).*

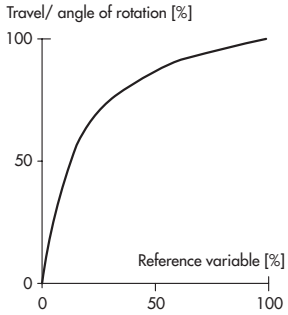
Linear (select characteristic: 0)



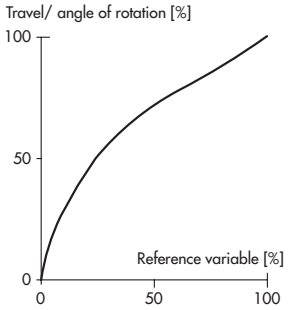
Equal percentage (select characteristic: 1)



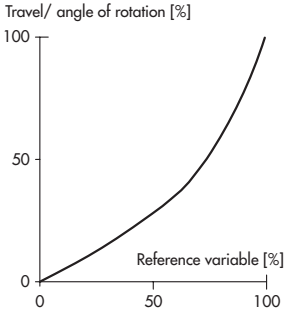
Rev. equal percentage (select characteristic: 2)



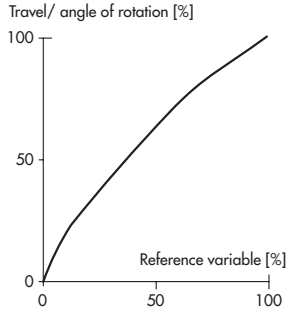
SAMSON butterfly valve, linear
(select characteristic: 3)



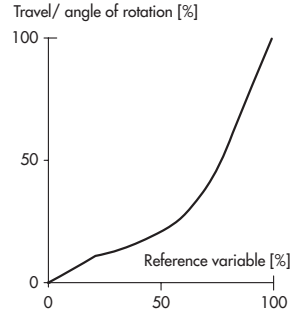
SAMSON butterfly valve, equal percentage
(select characteristic: 4)



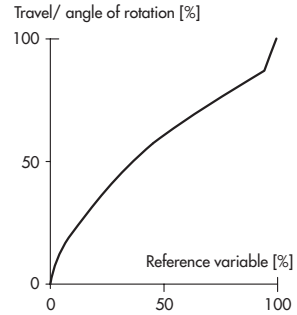
VETEC rotary plug valve, linear
(select characteristic: 5)



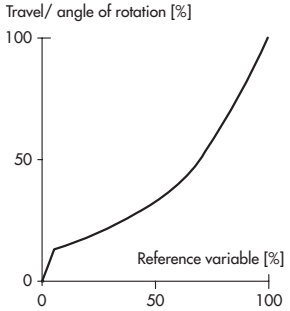
VETEC rotary plug valve, equal percentage
(select characteristic: 6)



Segmented ball valve, linear
(select characteristic: 7)



Segmented ball valve, equal percentage
(select characteristic: 7)



(1) # EC-TYPE-EXAMINATION CERTIFICATE

(Translation)

(2) Equipment and Protective Systems Intended for Use in Potentially Explosive Atmospheres - **Directive 94/9/EC**

(3) EC-type-examination Certificate Number:

PTB 10 ATEX 2007

(4)	Equipment:	Digital positioner, type 3730-6-110 and 3730-6-210 with HART communication
(5)	Manufacturer:	SAMSON AG Mess- und Regeltechnik
(6)	Address:	Weismüllerstr. 3, 60314 Frankfurt, Germany

(7) This equipment and any acceptable variation thereto are specified in the schedule to this certificate and the documents therein referred to.

(8) The Physikalisch-Technische Bundesanstalt, notified body No. 0102 in accordance with Article 9 of the Council Directive 94/9/EC of 23 March 1994, certifies that this equipment has been found to comply with the Essential Health and Safety Requirements relating to the design and construction of equipment and protective systems intended for use in potentially explosive atmospheres, given in Annex II to the Directive.

The examination and test results are recorded in the confidential assessment and test report PTB Ex 10-29351.

(9) Compliance with the Essential Health and Safety Requirements has been assured by compliance with:

EN 60079-0:2006 **EN 60079-11:2007** **EN 61241-0:2006** **EN 61241-1:2004**

(10) If the sign "X" is placed after the certificate number, it indicates that the equipment is subject to special conditions for safe use specified in the schedule to this certificate.

(11) This EC-type-examination Certificate relates only to the design, examination and tests of the specified equipment in accordance to the Directive 94/9/EC. Further requirements of the Directive apply to the manufacturing process and supply of this equipment. These are not covered by this certificate.

(12) The marking of the equipment shall include the following:

Ex see (15) Description

Zertifizierungssektor Explosionsschutz
On behalf of PTB:

Braunschweig, August 18, 2010

Dr.-Ing. U. Johannsen
Direktor und Professor

ZSEx10100e.dot

EC-type-examination Certificates without signature and official stamp shall not be valid. The certificates may be circulated only without alteration. Extracts or alterations are subject to approval by the Physikalisch-Technische Bundesanstalt.
In case of dispute, the German text shall prevail.
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Physikalisch-Technische Bundesanstalt
Braunschweig und Berlin

(13) # SCHEDULE

(14) **EC-TYPE-EXAMINATION CERTIFICATE PTB 10 ATEX 2007**

(15) Description of equipment

The digital positioner with HART communication is a single or double acting positioner. It is used for the conversion of electrical actuating signals into pneumatic actuating pressure signals.

The equipment is installed inside the hazardous area.

The equipment is available in two designes, type 3730-6-110 and type 3730-6-210 with a field barrier connected in series.

Marking

Type 3730-6-110

Ex **II 2 G Ex ia IIC/IIB T6** and
Ex **II 2 D Ex tD A21 IP66 T80 °C**

Type 3730-6-210 with field barrier, type 3770-1

Ex **II 2 G Ex d[ia] IIC/IIB T6** and
Ex **II 2 D Ex tD A21 IP66 T80 °C**

For relationship between type of protection, temperature class, options and permissible ambient temperature range, reference is made to the table:

Type of protection / Options		Permissible ambient temperature range
Ex ia IIC	T6	-55 °C ... 60 °C
	T5	-55 °C ... 70 °C
	T4	-55 °C ... 80 °C
Option, structure-borne sound sensor		-40 °C ... 60 °C
		-40 °C ... 70 °C
		-40 °C ... 80 °C

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Electrical data

Type 3730-6-210 with field barrier, type 3770-1 connected in series

Operating values: 4 ... 20 mA

Supply circuit ..... U_n = 10 V
or NAMUR-limit contact U_m = 250 V

Type 3730-6-110

The positioner may be connected to certified intrinsically safe circuits provided the permissible maximum values for U_i, I_i and P_i are not exceeded.

The circuits for the voltage/power supply, the serial SSP interface and the external position sensor are operationally interconnected and safely electrically isolated from the other intrinsically safe circuits up to a peak value of the nominal voltage of 60 V. The intrinsically safe circuits are safely electrically isolated from each other up to a peak value of the nominal voltage of 60 V. All circuits are safely isolated from ground.

Operating values: 4 ... 20 mA

Voltage/power supply ..... type of protection Ex ia IIC/IIB
(terminals 11/12) only for connection to a certified intrinsically safe circuit

Maximum values:

U_i = 28 V
I_i = 115 mA

or

U_i = 32 V
I_i = 87 mA
P_i = 1 W

C_i = 5.3 nF
L_i negligibly low

Position check-back ..... type of protection Ex ia IIC/IIB
(terminals 31/32) only for connection to a certified intrinsically safe circuit

Maximum values:

U_i = 28 V
I_i = 115 mA

EC-type-examination Certificates without signature and official stamp shall not be valid. The certificates may be circulated only without alteration. Extracts or alterations are subject to approval by the Physikalisch-Technische Bundesanstalt.
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or

U_i = 32 V
I_i = 87.5 mA
P_i = 1 W

C_i = 5.3 nF
L_i negligibly low

or

Binary input ..... type of protection Ex ia IIC/IIB
(terminals 31/32) only for connection to a certified intrinsically safe circuit

Maximum values:

U_i = 30 V
I_i = 100 mA

C_i = 56.3 nF
L_i negligibly low

or

Structure-borne sound sensor (passive) ..... Maximum values:
(terminals 31/32)

U_i = 30 V
I_i = 100 mA

C_o = 1.4 nF

C_i = 5.3 nF
L_i negligibly low

Inductive limit contact ..... type of protection Ex ia IIC/IIB
(terminals 41/42) only for connection to a certified intrinsically safe circuit

Maximum values:

U_i = 16 V
I_i = 52 mA
P_i = 169 mW

or

U_i = 16 V
I_i = 25 mA
P_i = 64 mW

C_i = 30 nF
L_i = 100 µH

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For relationship between temperature class, permissible ranges of the ambient temperature, maximum short-circuit currents and maximum power for analyzing units, reference is made to the table:

Temperature class	Permissible ambient temperature range	I_o / P_o
T6	... 45 °C	52 mA / 169 mW
T5	-55 °C ... 60 °C	
T4	... 75 °C	
T6	... 60 °C	25 mA / 64 mW
T5	-55 °C ... 80 °C	
T4	... 80 °C	

Software-limit contact ..... type of protection Ex ia IIC/IIB
(terminals 41/42 and 51/52) only for connection to a certified intrinsically safe circuit

Maximum values:

U_i = 20 V
I_i = 60 mA
P_i = 250 mW
C_i = 5.3 nF
L_i negligibly low

Magnet valve ..... type of protection Ex ia IIC/IIB
(terminals 81/82) only for connection to a certified intrinsically safe circuit

Maximum values:

U_i = 28 V
I_i = 115 mA

or

U_i = 32 V
I_i = 87.5 mA

C_i = 5.3 nF
L_i negligibly low

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Fault signal output ..... type of protection Ex ia IIC/IIB
(terminals 83/84) only for connection to a certified intrinsically safe circuit

Maximum values:

U_i = 20 V
I_i = 60 mA
P_i = 250 mW
C_i = 5.3 nF
L_i negligibly low

Serial SSP interface ..... type of protection Ex ia IIC/IIB
(plug connector)

Maximum values (active):

U_o = 7.88 V
I_o = 69.2 mA
P_o = 137 mW

linear characteristic

C_o = 650 nF
L_o = 10 mH

or

only for connection to a certified intrinsically safe circuit

Maximum values (passive):

U_i = 20 V
I_i = 60 mA
P_i = 200 mW
C_i negligibly low
L_i negligibly low

External position sensor ..... type of protection Ex ia IIC/IIB
(Analog PCB, pins p9, p10, p11)

Maximum values:

U_o = 7.88 V
I_o = 13.2 mA
P_o = 27 mW

linear characteristic

L_o = 10 mH
C_o = 1 µF

L_i = 370 µH
C_i = 66 nF

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SCHEDULE TO EC-TYPE-EXAMINATION CERTIFICATE PTB 10 ATEX 2007

(16) Assessment and test report PTB Ex 10-29351

(17) Special conditions for safe use

none

(18) Essential health and safety requirements

met by compliance with the standards mentioned above

Zertifizierungssektor Explosionsschutz
On behalf of PTB:

Braunschweig, August 18, 2010

Dr.-Ing. U. Johannsmeyer
Direktor und Professor

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Physikalisch-Technische Bundesanstalt

Braunschweig und Berlin

(1) **CONFORMITY STATEMENT**

(Translation)

(2) Equipment and Protective Systems Intended for Use in Potentially Explosive Atmospheres - **Directive 94/9/EC**

(3) Test Certificate Number:

PTB 10 ATEX 2008 X

(4) Equipment: Digital positioner, type 3730-6-810

(5) Manufacturer: SAMSON AG Mess- und Regeltechnik

(6) Address: Weismüllerstr. 3, 60314 Frankfurt, Germany

(7) This equipment and any acceptable variation thereto are specified in the schedule to this certificate and the documents therein referred to.

(8) The Physikalisch-Technische Bundesanstalt, on the basis of the Council Directive 94/9/EC of 23 March 1994, certifies that this equipment has been found to comply with the Essential Health and Safety Requirements relating to the design and construction of equipment and protective systems intended for use in potentially explosive atmospheres, given in Annex II to the Directive.

The examination and test results are recorded in the confidential assessment and test report PTB Ex 10-29352.

(9) Compliance with the Essential Health and Safety Requirements has been assured by compliance with:
EN 60079-0:2006 **EN 60079-15:2005** **EN 61241-0:2006** **EN 61241-1:2004**

(10) If the sign "X" is placed after the certificate number, it indicates that the equipment is subject to special conditions for safe use specified in the schedule to this certificate.

(11) This Conformity Statement relates only to the design and construction of the specified equipment in accordance with Directive 94/9/EC. Further requirements of this Directive apply to the manufacture and supply of this equipment.

(12) The marking of the equipment shall include the following:

II 3 G Ex nA II T6 or II 3 G Ex nL IIC/IIB T6 or II 3 D Ex tD A22 IP66 T80 °C

Zertifizierungssektor Explosionsschutz
On behalf of PTB:

Braunschweig, August 18, 2010

Dr.-Ing. U. Johannsmeyer
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(13) **SCHEDULE**

(14) **CONFORMITY STATEMENT PTB 10 ATEX 2008 X**

(15) Description of equipment

The digital positioner of type 3730-6-810 with HART communication is a single or double acting positioner. It is used for the conversion of electrical actuating signals into pneumatic actuating pressure signals.

The equipment is installed inside the hazardous area.

For relationship between type of protection, temperature class, options and permissible ambient temperature range, reference is made to the table:

Type of protection / Options		Permissible ambient temperature range
Ex nA IIC or Ex nL IIC	T6	60 °C
	T5	-55 °C ... 70 °C
	T4	80 °C
Option, structure-borne sound sensor		60 °C
		-40 °C ... 70 °C
		80 °C

Electrical data

Signal circuit ..... type of protection Ex nA II
(terminals 11/12)

Maximum operational values:

I = 4 ... 20 mA

or

type of protection Ex nL IIC/IIB

U = 32 V
I = 132 mA
P = 1.2 W

L = negligibly low
C = 5.3 nF

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Position check-back ..... type of protection Ex nA II
or binary input
or structure-borne sound sensor
(terminals 31/32)

Maximum operational values:
I = 4 ... 20 mA

or

type of protection Ex nL IIC/IIB

U = 32 V
I = 132 mA

L = negligibly low
C = 56.3 nF

Inductive limit contact ..... type of protection Ex nA II
(terminals 41/42)

Maximum operational values:

U = 8 V
I = 8 mA

or

type of protection Ex nL IIC/IIB

U = 20 V
I = 52 mA
P = 169 mW

or

U = 20 V
I = 25 mA
P = 64 mW

L = 100 µH
C = 30 nF

For relationship between temperature class, permissible ranges of the ambient temperature, maximum short-circuit currents and maximum power for analyzing units, reference is made to the table:

Temperature class	Permissible ambient temperature range	I_o / P_o
T6	... 45 °C	52 mA / 169 mW
T5	-55 °C ... 60 °C	
T4	... 75 °C	
T6	... 60 °C	25 mA / 64 mW
T5	-55 °C ... 80 °C	
T4	... 80 °C	

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Software-limit contact ..... type of protection Ex nA II
(terminals 41/42 and 51/52)

Maximum operational values:

U = 8 V
I = 8 mA

or

type of protection Ex nL IIC/IIB

U = 20 V
I = 60 mA
P = 400 mW

L = negligibly low
C = 5.3 nF

Magnet valve ..... type of protection Ex nA II
(terminals 81/82)

Maximum operational values:

U = 6 ... 24 V DC

or

type of protection Ex nL IIC/IIB

U = 32 V
I = 132 mA

L = negligibly low
C = 5.3 nF

Fault signal output ..... type of protection Ex nA II
(terminals 83/84)

Maximum operational values:

U = 8 V
I = 8 mA

or

type of protection Ex nL IIC/IIB

U = 20 V
I = 60 mA
P = 400 mW

L = negligibly low
C = 5.3 nF

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SCHEDULE TO EC-TYPE-EXAMINATION CERTIFICATE PTB 10 ATEX 2008 X

Serial SSP interface ..... type of protection Ex nA II
(plug connector)

Maximum operational values:

U = 8 V DC
I = 20 mA

or

type of protection Ex nL IIC/IIB

U = 20 V
I = 60 mA
P = 200 mW

L = negligibly low
C = 5.3 nF

External position sensor ..... type of protection Ex nA II
(Analog PCB, pins p9, p10, p11) or Ex nL IIC/IIB

Maximum operational values:

U = 7.88 V
I = 61 mA
P = 120 mW

L = 10 mH
C = 1 µF

(16) Assessment and test report PTB Ex 10-29352

(17) Special conditions for safe use

Type of protection Ex nA II:

A fuse according to IEC 60127-2/II, 250 V F or IEC 60127-2/VI, 250 V T with a nominal fuse current of max. 80 mA shall be connected in series to the signal circuit and to the position check-back circuit.

A fuse according to IEC 60127-2/II, 250 V F or IEC 60127-2/VI, 250 V T with a nominal fuse current of max. 40 mA shall be connected in series to the serial SSP interface.

All fuses shall be installed outside of the hazardous area.

Type of protection Ex nL IIC:

No fuses are required for the operation with energy-limited circuits of type of protection Ex nL IIC.

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(18) Essential health and safety requirements

met by compliance with the standards mentioned above

Zertifizierungssektor Explosionsschutz
On behalf of PTB:

Dr.-Ing. U. Johannsmeier
Direktor und Professor

Braunschweig, August 18, 2010

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